

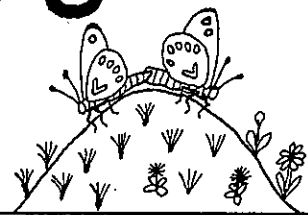
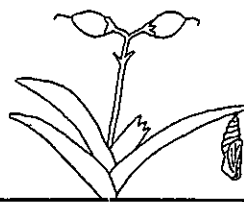
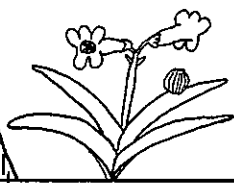


PAPILIO

NEW
SERIES

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HOSTPLANT RECORDS FOR BUTTERFLIES AND SKIPPERS
(MOSTLY FROM COLORADO) 1959-1992, WITH NEW LIFE HISTORIES AND NOTES ON
OVIPOSITION, IMMATURES, AND ECOLOGY

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Abstract. Hostplants of larvae, based on about 3090 records of observed ovipositions (a total of 1509) or discoveries of eggs, larvae, or pupae in nature, are presented for butterflies (including skippers), mostly from western United States, especially Colorado. The paper presents numerous new life histories, and many notes on egg placement, overwintering stage, behavior, and ecology. A new phenomenon of a butterfly egg mimicking a plant is reported, in which Nathalis iole eggs have changed color to match orange-yellow protruding foul-odor egg-shaped glands on Dyssodia papposa, presumably to benefit from lesser predation because predators think the eggs are inedible foul glands; this phenomenon is the complete opposite of the known cases of egg mimicry, in which plants produce structures mimicking butterfly eggs to deter oviposition (although possibly egg mimicry was the original origin of the precursor of the D. papposa glands). Dracula Caterpillars were found--larvae of Amblyscirtes--which have unique fangs unknown in other Lepidoptera, as well as ordinary mandibles; apparently the fangs are used in defense rather than nest-building. What was once called one species Celastrina argiolus in Colorado is now proven to be two species, with different hostplants, flight times, habitats, and pupal color; the localized species has two ecotypes, one feeding on Humulus vines, the other on Lupinus. Only one Hesperinae (Parisma parita) is truly polyphagous, eating grasses and sedges of many life forms; it has "satyr envy", converging to Satyrinae in its polyphagy, unique lack of larval nest, and cryptic striped larval color pattern. Hesperinae species generally eat only a certain life form of grass, and may prefer the biochemicals of certain grass species or genera, so that Hesperinae are comparatively host-specific. A hay-feeding guild was discovered: 6 Hesperinae (Piruna pirus, Ancyloxypha numitor, Ochlodes sylvanoides, Poanes zabulon taxiles, Amblyscirtes vialis, probably Anatrytone logan) that each eat numerous tall wide-leaf grasses. In contrast, many Satyrinae have rather haphazard oviposition, and rather polyphagous lab feeding, so that Satyrinae species are in general rather polyphagous on various grasses, or even on grasses and sedges, and their host specificity is difficult to determine. One satyr (Oeneis chryxus) oviposits on trees. In another case of convergence, Hesperia ottoe and Polites origenes are the only species in their genera to eat a broad-leaf grass and to have aerial larval nests. One skipper (Ancyloxypha) was found to have larval wax glands on four segments instead of the usual two. Bog butterflies seem to have rather polyphagous larvae. Some larvae rest underground: Parnassius (pupae), certain Satyrinae (Neominois, perhaps some Oeneis and Erebia), Hesperia relatives (Hesperia except ottoe, Polites except origenes, Yvretta, Hylephila, Atalopedes), and "Amblyscirtes" simius. Three species of Polites lay eggs without glue which drop into the litter, and Cercyonis does this about half the time. Anatrytone logan is a very distinct genus from Atrytone aroqos, in contrast to Hesperia, Polites, and Atalopedes, which are basically just one genus. Cases of hostplant switching is reported in which Euphydryas chalcedona/anicia capella now feeds on introduced Linaria dalmatica, and Phyciodes picta has switched from Aster to Convolvulus. Two new subspecies are named from lowland valleys of W Colo.-E Utah: Phyciodes tharos/morpheus riocolorado, the only valid ssp. of tharos, with paler wing color; and Hesperopsis libya confertiblanca, which has a solid white unh and a new hostplant.

INTRODUCTION

Hostplants are known for most northeastern U.S. butterfly species, and for many California species. But there are many more species in the Southern Rockies of western U.S., and far fewer scientists are there to study them, so hostplants are not well known for most western butterflies. This paper adds

2 greatly to the knowledge of hostplants of these species. Some of the springs and summers from 1977 to 1992 were spent observing females to obtain oviposition records, and raising the immatures of some species, mostly in Colorado. Before this time I had found other hostplants during the course of other work. All my data on hostplants through 1991 are given, together with associated information such as the hibernial diapause stage, the location of oviposition or larval feeding (leaves or fruits), etc. Descriptions of previously unknown eggs, larvae, and pupae are given (color slides were made also, but color photos cannot be given here). The hostplants through 1985 were already published (Scott 1986a, *Papilio* [New Series] #4), but I decided to include them in the present paper because recent work more than quintuples the total amount of data, because inclusion of those records does not lengthen the present paper much, because the present paper corrects more than a dozen plant misidentifications in that paper, because in most cases the interpretation of the results is far better when all the results are grouped together, and because I wish to maintain a lifetime list of hostplants as a service to readers.

The plant family of most hostplants, and the justification for the scientific names of the butterflies used, can be found in Scott (1986b). Scott (1986b) also summarizes the general ecology, distribution, behavior, and identification of each species. The hostplant records in Scott (1986b) are either from Scott (1986a), or from the literature; the literature sources for each hostplant record therein are listed in my card file, and are available to readers on request for a small fee. Flight periods and other ecological observations on the Colorado fauna were given by Scott & Scott (1980) and Scott and Epstein (1986).

Methods

To obtain oviposition records, the observer must train himself to recognize the fluttering oviposition flight typical of butterflies. One should walk about the habitat and watch for any female which flutters or hovers slowly from plant to plant; ovipositing females flutter slowly while searching for an oviposition site, and frequently land, whereas males and non-ovipositing females fly more erratically or swiftly. This distinction is very noticable in most butterflies, especially in fast-flying skippers; but in Satyrinae (Lethe, Cercyonis, Neominois, Oeneis, Erebia, etc.) the flight of ovipositing females is only slightly more fluttering than usual. Papilio females continue to flutter while they oviposit, while other butterflies are generally motionless. Unfortunately, most lepidopterists only collect adults, and are trained to automatically swing their net at the first sight of an adult, especially a hovering female that is so tempting and easy to capture, so they rarely see ovipositions. But if they just trained themselves to NOT swing if the adult is hovering slowly, they could follow the female to oviposition, and then they could swing the net AFTER the egg is laid. By carefully stalking the hovering female and watching where the egg is laid, one can get both the egg and the female in most cases. Collectors who catch butterflies that do not hover slowly (the majority of the butterflies seen), and watch those that do hover slowly, can catch almost as many adults as collectors who catch every adult seen, and can obtain almost as many ovipositions as people who watch and do not collect adults at all. (And, very peculiarly, most modern "Butterfly Watchers", such as those associated with bird watching societies, are more interested in other things than butterfly biology, and strangely do not observe or report ovipositions and seldom contribute to scientific knowledge.) Thus there is no big conflict between collecting and observing ovipositions, so lepidopterists--even collectors--have no excuse for not obtaining ovipositions.

Species that oviposit haphazardly require special methods, which take more effort. Parnassius, Speyeria, Boloria, and grass/sedge feeders (most Satyrinae, some Hesperinae) often oviposit haphazardly. Because an egg of these species may have been laid haphazardly on a plant that the larvae may not feed on, and the larva then wanders to find a suitable plant, merely recording the oviposition plant is totally inadequate. Therefore, in the last few years I recorded all possible hostplants (all monocotyledons for the last two groups) within 1 m of the egg. Proof that a haphazard-oviposition species uses a given plant as a hostplant requires effort both in field and lab: adults must be associated with that plant in nature; females must oviposit on or near that plant in nature; and larvae must successfully feed on that plant in the lab. Thus, ideally, many ovipositions should be observed in nature, and lab feeding tests should be conducted to determine whether the native plants near the eggs are eaten or rejected by larvae.

All times are given as 24-hour standard time.

I thank the following persons, especially Dr. Weber, for identifying the hosts (abbreviation in parentheses): William A. Weber (W--University of Colorado Herbarium, Boulder Colo.), June McGaskill (M--University of California Herbarium, Davis, Calif.), James Harding (Ha--same address), Beecher Crampton (C--same address) James L. Reveal (R--Univ. of Maryland, College Park, Md.), John R. Keith, Hansford T. Shacklette, James A. Erdman (all three G--U.S. Geological Survey, Lakewood, Colorado), Farrel Branson (B--same address), L. R. Heckard (H--Univ. Calif., Berkeley, Calif.), John Strother (same address, no abbreviation), Charles Fiedema (F--U.S. Dept. Agriculture, Fort Collins, Colo.). If no letter is given, I identified the plant; in recent years I have gained considerable expertise in plant identification, so have seldom consulted these botanists.

Pressed plant specimens documenting many of the hostplant records are in the collection of J. Scott. Because most of the plants are not in perfect condition, they would no doubt be thrown away by herbaria, which generally retain only perfect specimens. I have heard valid stories of famous herbaria throwing out even new county record specimens of plants if the plants are not in absolutely perfect condition. Because butterfly females very often choose juvenile plants, or plants without inflorescences, or plants not in perfect condition, and because entomologists are less skilled than botanists at drying and pressing plant specimens, butterfly hostplants rarely turn into ideal herbarium specimens. Making perfect botanical specimens takes considerable experience, demands great care in changing the blotters frequently and using cumbersome heaters/driers etc., and requires the selection of perfect wild specimens. Even if the current herbarium curator is sympathetic to the retention of non-ideal specimens that represent hostplant records, a later curator may not be. Also, most butterfly hostplants are rather common plant species (because any butterfly species that prefers a rare plant would soon become extinct), and herbarium curators want rare plants or odd varieties, not common plants. Therefore, I strongly believe that insect hostplants should NOT in general be placed in herbaria; they should be placed with the associated insect collection. Retaining plant specimens also makes resubmitting plants to other botanists with new knowledge of the plant group much easier; very few botanists care about insects that feed on plants, and if a Lepidopterist tries to reexamine a certain plant it is too much of a nuisance to try to relocate the plant in scattered herbaria and ask the curator to have it reidentified. These curators want to do taxonomy of their favorite plant group and do not wish to be bothered by mundane identifications. As I gained expertise regarding the identification of plant groups used as butterfly hostplants, I reexamined preserved oviposition plants from prior years that had been identified by various botanist "experts", or I sent the plants to other experts; too often, I have been disappointed to find that the first "experts" had misidentified the plants. In a few cases, the misidentifications were obvious and blatant. About a dozen of these misidentifications are corrected herein, including some longstanding misidentifications that have crept into popular books. Insect hostplant specimens should be kept with the insect collection; in general, herbaria neither need nor want these specimens.

The hostplant should be pressed and preserved unless its identification is very obvious. Most lepidopterists are rather sloppy regarding plant identifications; of course, anyone without expert knowledge of the oviposition plant genus should collect it (roots and all, plus nearby plants with inflorescences in another newspaper if the oviposition plant lacks inflorescence) and place it between folded newspapers and write locality date time and species on the newspaper so an expert can identify it. A frequent problem in identifying plants is that a person may have identified what looks like the current plant in the past, and therefore assumes that the current plant is that species; but botanists--like all taxonomists--tend to split their species to the limit of resolution (new microscopes and new techniques lead to the naming of new species and varieties), so a plant that looks like a known plant could be a closely related plant species. Many closely-related plant species can be confused: many plants look very similar to the non-expert; the floras generally lack drawings or photos of the plants; the keys in floras are often written in vague terminology that makes a decision difficult; complete descriptions of the plant are often lacking; descriptions are written in technical terminology that is difficult for the beginner and often imprecise; and plants in general are more variable in morphology than animals, causing more difficulty in identification. What is needed are floras that contain identification tables, in which each character is described for every species (or genus), so that plant specimens that contain missing parts can still be identified (keys make use of very few traits, so can lead to very gross

4 misidentifications, a problem solved by tables); floras should also contain drawings or photos. Such ideal floras are unfortunately lacking for the Rocky Mountain region (Colorado floras also lack adequate habitat and range and blooming information).

Nomenclature of plants is in a state of flux, just as is the nomenclature of insects. Plant varieties may even change species (for instance var. xanthum went from Eriogonum flavum to E. jamesii). The most recent local Colorado plant identification guides in particular place numerous plant species in new genera. A bizarre rule of plant nomenclature sometimes causes the species name to change when a different genus name is adopted (for instance Potentilla fruticosa became Pentaphylloides floribunda, ad nauseum). Generic reassignments that represent a correction of evolutionary relationships are valuable progress, but mere generic splitting is of little value. I have used generic names from national plant checklists and famous multi-state floras (such as the recent Great Plains Flora) rather than rudimentary local identification guides (lacking habitat and range and descriptive information) that are orgies of splitting.

Old floras treated the grasses Agropyron, Elymus, and Sitanion as distinct genera, but recent morphological and chromosome studies synonymized Sitanion into Elymus, reshuffled the species between the first two genera, and outlined several groups within Agropyron that have equal rank with Elymus. Some recent floras split these grasses into as little as two or as many as ten genera, but it is obvious that they form one phylogenetic unit in which the species frequently hybridize (for instance "Pascopyrum" smithii has a large chromosome number due to its hybrid ancestry Agropyron dasystachyum X "Elymus" triticoideus), so I treat them all as Agropyron, and list the subgenus to reduce inevitable confusion. The most recent local identification manual places dasystachyum into Elytrigia, which is contrary to its genome (SH, like Elymus); I treat it as A. (Elymus) dasystachyum.

PAPILIONIDAE

Papilioninae

Papilionini

Females usually continue to hover when ovipositing. Eggs are generally laid on the hostplant.

Papilio machaon bairdii Edw. Larvae on Artemisia (Oligosporus) dracunculus, 2 mi. SW Canon City, Fremont Co. Colo., June 27, 1971. Larvae on A. dracunculus, 1 mi. W Wolf Park, Fremont Co. Colo., June 27, 1971. Larvae on A. dracunculus, S of Salida, Chaffee Co. Colo., Aug. 1985. Larvae on A. dracunculus, Beaver Creek, 8100', E of Phantom Can., Fremont Co. Colo., June 30, 1971, Glenn R. Scott. Larvae eat leaves. Adults apparently have only one flight in the Front Range near Denver (mostly July), whereas in S Colo. adults fly from May-early Sept. in several flights, though adults are evidently most common in late June.

Papilio zelicaon Lucas. Larva on inflorescence of Foeniculum vulgare, Berkeley Hills, Contra Costa Co. Calif., July 1968. Larva on F. vulgare leaves, Point Richmond, Contra Costa Co. Calif., May 2 and 17, 1971, June 15, 1972. Oviposition 9:13 on leaf of Harbouria trachypleura, Green Mtn., Jefferson Co. Colo., June 3, 1980. Adults assoc. with H. trachypleura (6), Pass Creek, Huerfano Co. Colo., June 26, 1971, and many other central Colo. sites. Preoviposition 12:45 on H. trachypleura, Green Mtn., Jefferson Co. Colo., May 18, 1986. Oviposition on leaf of Conium maculatum, Red Rocks, Jefferson Co. Colo., June 16, 1981. Older larvae may prefer umbels. Native up to 12,500' in the alpine zone of Park Co. Colo. One flight in Colo.; adults as late as late July in the foothills of the Front Range are perhaps just stragglers from the one flight. Pupae hibernate.

Papilio polyxenes asterius Stoll. Larva on Daucus carota (W), Lakewood, Jefferson Co. Colo., Sept. 5, 1972. Oviposition 13:00 on underside of leaf of Conium maculatum (W), Castlewood Res., Douglas Co. Colo., Aug. 13, 1977. 6 eggs found on C. maculatum (W) leaves, Lakewood, Jefferson Co. Colo., Aug. 17, 1977. Preoviposition 9:45 on C. maculatum, Red Rocks, Jefferson Co. Colo., June 15, 1987. Ovipositions 10:10, 10:11 on underside of small (blade 10 cm long) lower C. maculatum leaves; Apex Gulch, Jefferson Co. Colo., Aug. 27, 1990. Oviposition 10:12 under young C. maculatum leaf, Wheatridge, Jefferson Co. Colo., July 31, 1991. 4 2nd-stage and 1 3rd-stage larvae found on top of C. maculatum leaves, Wheatridge, Jefferson Co. Colo., Aug. 17, 1991. Egg found on top of C. maculatum green leaf, Wheatridge, Jefferson Co. Colo., Aug. 22, 1991. Oviposition on Berula erecta (W), wet meadow 7.2 mi. N New Mexico state line, Hwy. 550, La Plata Co. Colo., Aug. 27, 1977. Adults assoc. with B. erecta, 1 mi. S Cochiti Dam, Sandoval Co. New Mex., Sept. 9, 1977. Oviposition 9:10 on B.

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erecta (W), NE Lochiel, Santa Cruz Co. Ariz., Aug. 7, 1986. Larva on Cicuta douglasii (W) inflorescence, Sapello Can., 7800', San Miguel Co. New Mex., Aug. 23, 1978. Larva on C. douglasii (W), Hot Springs, 7000', San Miguel Co. New Mex., Aug. 23, 1978. 1 egg found on leaflet and preoviposition 13:20, both on C. douglasii, Wheatridge, Jefferson Co. Colo., July 6, 1991. 4th stage larva on Petroselinum crispum umbel, Lakewood, Jefferson Co. Colo., July 22, 1985. 1 live egg and 2 hollow eggshells found on P. crispum maturing seeds, Lakewood, Jefferson Co. Colo., Aug. 11, 1989. Oviposition 10:07 on Anethum graveolens umbel, Lakewood, Colo., July 22, 1985. Larvae found on A. graveolens by Laura Pestorius, 2 mi. NE Conger, Freeborn Co., Minn., June, 1986. Adults associated with Pastinaca sativa var. sylvestris, 5 mi. SW Elkhart, Polk Co. Iowa, June 18, 1987, and Helmer Myre State Park, Freeborn Co., Minn., June 22-25, 1987, and roadside ditches NE of Conger, Freeborn Co., Minn., 1986-1987. Adults associated with P. sativa & Conium maculatum, NE Alden, Freeborn Co., Minn., June 23, 1991. Preoviposition Harbouria trachypleura, Green Mtn., Jefferson Co. Colo., Sept. 1, 1987. C. maculatum (sometimes H. trachypleura) is the main host in the Front Range foothills, and C. maculatum is the main host on the plains. Older larvae seem to prefer umbels rather than leaves. Three flights occur in the Colo. foothills. EGG light greenish-yellow, becoming orangish-yellow. FIRST-STAGE LARVA black, with slight cream mottling on front of thorax and on top of middle of body.

Papilio indra indra Reakirt. Oviposition 9:05 on leaflet of Harbouria trachypleura, Green Mtn., Jefferson Co. Colo., June 3, 1980. Oviposition 11:35 on leaflet of H. trachypleura, S of Golden Gate Can., Jefferson Co. Colo., June 5, 1980. Preoviposition on H. trachypleura, 1 mi. NW Idledale, Jefferson Co. Colo., June 13, 1980. This host is not especially bushy, and grows on sandy/pebbly slopes rather than among rocks; most P. indra hosts are bushy and grow among rocks. Preoviposition on Aletes acaulis, Coal Creek Can., Jefferson Co. Colo., July 1, 1986; A. acaulis is a known host in the Front Range (John F. Emmel & Richard Skalski, pers. comm.). Adults (ssp. like indra but long tail) assoc. with Lomatium gravei (W), Jones Hole, Dinosaur Nat. Mon., Utah, June 11, 1973.

P. cresphontes Cramer. Larvae common on Citrus sinensis, Phoenix, Maricopa Co. Ariz., Oct. 3, 1971.

P. glaucus rutulus Lucas. Larva on Salix babylonica reared, Pueblo, Pueblo Co. Colo., Aug. 1962. Oviposition 12:10 Salix exigua, N Fork Clear Creek, Gilpin Co. Colo., July 1, 1981. Ovipositions 15:45-15:55 on upperside of leaves about 10 m up in two trees of Populus angustifolia (about 15 eggs seemed to be laid though the height was too great to be sure, the female grasps a leaf and flutters while she bends her abdomen beneath her to lay), Mt. Vernon Historic Site, Jefferson Co. Colo., July 11, 1984. Ssp. rutulus is common and has several flights in the suburbs of Denver, Colo., where the imported deciduous trees would seem to be ideal for ssp. glaucus; probably glaucus is not present because the few glaucus that do fly in (I have caught only two adult glaucus [both ident. by wing pattern and valva prong shape]: 1 male spring form Jarre Can., Douglas Co. Colo., April 30, 1981; 1 male summer form Tinytown, Jefferson Co. Colo., July 2, 1991) hybridize and are swamped by the rutulus population; or perhaps ssp. glaucus requires a moister climate. TAXONOMIC NOTE: A female was found Tinytown, Jefferson Co. Colo., June 17, 1992, that is intermediate between glaucus and rutulus (chitinous flap beside ostium intermediate in shape, unh apical spot mostly orange, orangish flush over other unh submarginal spots and on median area, a unf submarginal solid yellow band) being courted by male rutulus and contained 1 spermatophore; this proves that she had already mated with a rutulus as had her parent; previously I have found 2 male P. glaucus glaucus in the Front Range where it is very rare (1 at Jarre Can. Douglas Co., one here at Tinytown the previous year 1991, which could have been the father of this female), but this female is the first evidence in Colorado that glaucus and rutulus hybridize as they do elsewhere (SE B.C. where most adults are intermediate [Scott & Shepard 1976 using measurements of male and female genitalia and wing traits], Mont., the Black Hills, etc.); use of the biological species concept still suggests that rutulus, canadensis, and glaucus are ssp. which intergrade in all traits of morphology and biology. The only real evidence concerning any reproductive isolation martialled for the recent separation of canadensis from glaucus by Hagen et al. (1991) is that a minority of females do not emerge from lab pupal diapause in the cross glaucus female X canadensis male (most families produce fewer females, but some produce fewer males) (the cross glaucus male X canadensis female produces a 1:1 sex ratio). Considering the vast amount of data documenting the intergradation of canadensis and glaucus including clines over vast areas in many traits, and the lack of sympatry between any two taxa without overwhelming interbreeding, and the fact

6 that these taxa are more subspecies--adapted to one generation in canadensis versus 2 or more in glaucus--than separate species.

P. eurymedon Lucas. Oviposition on small shrub of Prunus emarginata (M), Loon Lake, El Dorado Co. Calif., June 30, 1974. Oviposition 11:00 Ceanothus fendleri leaf top (female hovered during laying), Crawford Gulch, Jefferson Co. Colo., June 24, 1992.

P. multicaudata Kirby. Larvae found on leaves of Prunus (Padus) virginiana var. melanocarpa and Fraxinus pensylvanica var. lanceolata, Flintwood Hills, Douglas Co. Colo., Aug. 13, 1977, Carl Decker and J. Scott. Oviposition 11:00 on upperside of leaf of P. v. var. melanocarpa, Apex County Park, Jefferson Co. Colo., June 24, 1980. Oviposition 11:15 on top of P. v. var. melanocarpa leaf, Red Rocks, Jefferson Co. Colo., June 25, 1989. Eggs and young larvae (probably multicaudata) found on P. v. var. melanocarpa by Richard M. Peigler, Lakewood, Jefferson Co. Colo., July 21, 1989. 1st-stage larva found on Fraxinus pensylvanica var. lanceolata leaf, Lakewood, Jefferson Co. Colo., July 31, 1989. P. v. var. melanocarpa must be the main hostplant, except in towns where Fraxinus is the main host. Also a common suburban Denver resident with several flights. EGG bright green, later turning reddish-brown as larva develops. FIRST-STAGE LARVA mostly black, with a slight cream saddle in middle of body, body with scoli; head black with 2 hornlike scoli. HALF-GROWN LARVA mottled dark-brown, the underside white, true legs tan, a white band starting up from underside on A1-3 at start and angling back to A3-5 on top of body, with rows of bumps on brown areas (longest bumps on thorax esp. T1, and on A9), two rows of blue spots (subdorsal spot on T3, A1, A5-7, dorsolateral spot on T3, A1, A4-7; head brownish-red (tan above labrum). MATURE LARVA yellow-green on top, blending to greenish-white on prolegs & legs and white on underside, anterior rim of T1 yellow, intersegmental area black on dorsal half of body between A1-2, this black line edged by yellowish-white anteriorly, on front of T3 a dorsolateral greenish-yellow doughnut-shaped "eyespot", outlined inside and outside by a black line, the doughnut thickest ventrally, the doughnut center yellow-green with a blue center spot, above the doughnut are two more small black-rimmed greenish-yellow satellite spots, one above the other, many blue spots (each ringed with black) occur (on T3 one spot in lower eyespot & one tiny spot between the two yellow satellite spots, on A1 and A4-7 are 1 subdorsal spot [tiny on A4] & 1 dorsolateral spot & 1 tiny spot below spiracle, on A2-3 a tiny subspiracular spot, on A8 a tiny dorsolateral spot & a tiny subspiracular spot), osmeteria orange, lower half of body has tiny white circles around tiny hairs; head brownish-orange. PUPA (Douglas Co. Colo.) light mottled brown, with a broad mottled-green lateral band esp. on abdomen, a broad whitish-tan area above that, a broad tan middorsal band above that (edged by brown spots and containing a middorsal brown line on middle abdominal segments), a dark-brown midventral line on abdomen, and green mottling on legs and posterior margin of wing. Pupae hibernate.

Troidini

Battus philenor (L.). Larvae on Aristolochia reticulata (small 5 cm tall grasslike shoots), 2 mi. W. Austin, Texas, Apr. 29, 1972. Wandering mature larva found (entirely orange-red in color! versus black in the rest of the range), Guadalupe Can., Hidalgo Co. New Mex., Aug. 3, 1986.

Parnassiinae

Parnassiini

Females do not flutter when ovipositing, and usually crawl on the ground for a few cm before ovipositing. Eggs are usually laid near the hostplant rather than on it.

Parnassius phoebus hermodur H. Edw. About 60 larvae found near or eating Sedum (Rhodiola) rosea integrifolia, Mt. Evans, 13,600', Clear Creek Co. Colo., July 14, 1980. Alpine populations may be biennial, hibernating as eggs and also as pupae; pupal diapause is not yet proven, but there is so little time for larvae to develop that bienniality is probable there. Larvae at lower altitude often pupate in a slight silk nest under grass clumps (B. Drummond, pers. comm.), and other persons observed slight silk nests spun by pupating larvae, but my 40 lab larvae spun no silk. I observed a larva at Mt. Evans worming itself into pebbly soil like a charmed cobra. Edwards (1868-1897) saw larvae squeezing through tiny holes, and adults ovipositing haphazardly. Thus larvae may also pupate in loose soil; pupal nests would be useful IF pupae hibernate. Two forewing base hooks (fig. by Scott 1986) probably hook onto grass, silk,

pebbles, etc. to pull the unexpanded adult out of the nest. Adults associated with Sedum lanceolatum at Loveland Pass and Mt. Evans and McClellan Mtn., Clear Creek Co., Colo. EGG dirty white. MATURE LARVA black, with the same yellow spots as ssp. smintheus, the subdorsal yellow spots varying from large to nearly absent on different larvae. PUPA head and wings dark-brown, rest of body red-brown, middorsal abdomen stripe dark-red-brown, with brownish-yellow spots from T2-end of abdomen in same positions as yellow spots of larva, spiracles brown, dark brown intersegmental areas form rings around abdomen.

Parnassius phoebus smintheus Dbldy. (=sayii Edw.). 3 eggs found on Carex sp. (B), 1 mi. N Cheesman Res., Jefferson Co. Colo., Sept. 7, 1971. Oviposition 13:37 on base of shrub trunk 30 cm from Sedum (Amerosedum) lanceolatum, Golden Gate Can., Jefferson Co. Colo., July 4, 1980. Ovipositions 10:08, 10:40, 10:48, 11:51, 12:03, 12:04, 12:06, 12:08, 12:48, and 13:45 on soil, dead twigs, Koeleria macrantha (a grass)(W), on two other species of grasses (grasses were the commonest oviposition site because of their abundance in the grassland), on one species of sedge, on Antennaria parvifolia, and on two other species of dicotyledons; all eggs laid near but not on S. lanceolatum which is the presumed hostplant at this locality; NE of Rosita, Custer Co. Colo., June 1969, June 1970, June 1971. Oviposition 10:25 on underside of Stellaria (Pseudostellaria) jamesiana leaf 10 cm. from S. lanceolatum (very common), Guy Hill, Jefferson Co. Colo., June 25, 1986. Oviposition 9:45 on dead Bouteloua gracilis leaf near S. lanceolatum, the egg hibernated, Guy Hill, Jefferson Co. Colo., June 27, 1986. 1 egg found on stick 10 cm from S. lanceolatum, 1 egg found on piece of bark 20 cm from S. lanceolatum, 1 egg found on Agoseris stem 20 cm from S. lanceolatum, 1 egg found on Astragalus flexuosus 20 cm from S. lanceolatum, 1 egg found on Lupinus argenteus stalk 10 cm from S. lanceolatum, oviposition 9:13 Oxytropis lambertii leaf 3 cm from S. lanceolatum (the last four oviposition sites are dicotyledons, whereas the remaining oviposition sites are grasses), 1 egg found on old Bromus tectorum 10 cm from S. lanceolatum, 5 eggs found on Agropyron (Pascopyrum) smithii 5, 10, 10, 20, 20 cm from S. lanceolatum, 6 eggs found on Bouteloua gracilis 10, 10, 10, 10, 20, 20 (on dead leaf) cm from S. lanceolatum, 3 eggs found on Carex probably pennsylvanica heliophila 2, 15, 20 cm from S. lanceolatum, 4 eggs found on Danthonia parryi 8, 15, 25, 25 cm from S. lanceolatum, 1 egg found on Agropyron (Elymus="Sitanion") longifolius 10 cm from S. lanceolatum, 7 eggs found on Festuca arizonica 15, 20, 30, 40, 40, 40, 50 cm from S. lanceolatum, 19 eggs found on Festuca saximontana 5, 5, 8, 8, 8, 8, 10, 10, 10, 10, 10, 15, 15, 20, 20, 40, 50, 80 cm from S. lanceolatum, 14 eggs found on Koeleria macrantha 5, 10, 10, 10, 15, 15 (on stem), 15, 20, 20, 20 (on dead blade), 20 (on dead blade), 20, 30, 30 cm from S. lanceolatum, 13 eggs found on Oryzopsis eximica 2, 5, 7, 10, 10, 15, 20, 20, 20, 25, 30, 30, 30 cm from S. lanceolatum, 1 egg found on Poa pratensis 5 cm from S. lanceolatum, 15 eggs found on Stipa comata 0.5, 2, 5, 5, 5, 5, 8, 15, 15, 20, 20, 20, 25, 50, 55 cm from S. lanceolatum, all Guy Hill, Jefferson Co. Colo., June 16, 17, 19, 20, 21, 24, 27, 1988, June 19, 20, 1989 (dicotyledons were not searched at this site, so dicotyledons surely are egg substrates also, probably about 50% of the time). 1 unhatched egg (containing fully-developed 1st-stage larva) found on Festuca saximontana leaf, proving that eggs hibernate (the larva inside), Guy Hill, Jefferson Co. Colo., Dec. 5, 1988; small S. lanceolatum plants were still green here on Dec. 5. Egg found on Andropogon (Schizachyrium) scoparius 15 cm from S. lanceolatum, White Ranch County Park, Jefferson Co. Colo., July 14, 1988. 4 eggs found on Carex rossii, 10, 17, 20, & 20 cm from S. lanceolatum; Crawford Gulch, Jefferson Co. Colo., July 5, 1990. 1 mature larva found eating small 5-cm-tall S. lanceolatum plant, Mt. Vernon Historic Site, Jefferson Co. Colo., June 4, 1991. Egg found on dead Festuca saximontana blade 25 cm from S. lanceolatum, N fork Clear Creek, Gilpin Co. Colo., July 18, 1991. Oviposition 10:00 green grass blade 8 cm from S. lanceolatum, Guy Hill, Jefferson Co. Colo., June 22, 1992. Females oviposit haphazardly: to oviposit, the female lands on the ground, and crawls to the nearest clump of grass or other plant to lay, often crawling to 3 or 4 clumps before laying. Eggs are laid an average of 17.4 cm away from the hostplant (based on 104 eggs found on grasses and the nearest hostplant recorded) rather than on it. Eggs hibernate. Adults fly in late spring, but because the hostplants are green in early spring (and apparently retain their succulent green leaves over winter as they were still green Dec. 5) the newly-hatched larvae have time to feed and grow to adults in spring. Scott (1973b) reports ecology, behavior, and movements. EGG dirty white. MATURE LARVA: body and head black, body with supralateral yellow spots (2 on T1, 3 [the posteriormost largest the middle spot smallest] on T2-A8) and subdorsal yellow spots (one on each T2-A8 segment); the one mature larva I found had the yellow subdorsal spots almost as large as the largest lateral yellow spots.

Colias meadii meadii Edw. Oviposition Trifolium dasyphyllum (G), Baldy Peak, Fremont Co. Colo., July 29, 1970. Oviposition 9:55 T. dasyphyllum (G), Hermit Pass, Custer Co. Colo., July 31, 1970. Oviposition T. dasyphyllum (G), Greenhorn Peak 12000', Pueblo Co. Colo., Aug. 1970. Oviposition 10:12 Trifolium nanum (W), Loveland Pass, Summit Co. Colo., July 25, 1978. Oviposition 11:40 on T. nanum leaflet, Hoosier Pass, Summit Co. Colo., Aug. 5, 1989. Oviposition 10:13 Trifolium parryi, Loveland Pass, Summit Co. Colo., July 28, 1978. Egg found on top of T. parryi leaf, reared to pupa; Loveland Pass, Summit Co. Colo., Aug. 8, 1990. Oviposition 10:33, preoviposition 10:00, and egg found, all on top of T. parryi leaves; Loveland Pass, Summit Co. Colo., Aug. 9, 1990. Early stages (Loveland Pass): EGG cream, turning orange after a day. FIRST-STAGE LARVA cream, after feeding turning yellow-green with short cream setae, a dark-green heart-line; head black with short cream setae. MATURE LARVA grass green, with a lateral white band (with no yellow-orange in it, unlike other Colias), a subdorsal narrow greenish-white line; underside and head lighter green. PUPA light green, with a lateral greenish-white band running from horn to cremaster (edged dorsally by blackish-green on head, edged by greenish-gray elsewhere, the band absent on eye and antenna and forewing base, the band nearly white on abdomen), a weak greenish-white subdorsal line from T2-cremaster, heart-band green from T2-cremaster and heart-band edged by a greenish-white line (this greenish-white edge and the subdorsal greenish-white line weakly form a wide paler-green band), small brown supraventral spots on abdomen, wing veins paler, wing center eventually becomes orange as the adult appears within, when the pupa becomes yellow.

Colias alexandra alexandra Edw. Ovipositions 9:52, 9:52 in middle of leaves of Thermopsis divaricarpa, Green Mtn., Jefferson Co. Colo., Aug. 16-17, 1972. Oviposition 14:30 on underside of leaf of T. divaricarpa, Red Rocks, Jefferson Co. Colo., July 12, 1980. Preoviposition seen and 3 eggs found on leaves (2 on upperside, 1 underside) of T. divaricarpa, Tinytown, Jefferson Co. Colo., July 20, 1984. Oviposition 10:32 on underside of leaf of T. divaricarpa, O'Fallon Park, Jefferson Co. Colo., Aug. 13, 1984. Oviposition 10:41 on underside of leaf of T. divaricarpa, Corwina Park, Jefferson Co. Colo., Aug. 17, 1984. Preoviposition T. divaricarpa, Green Mtn., Jefferson Co. Colo., June 8, 1985. Preoviposition 10:10 T. divaricarpa, NE Mt. Judge, Clear Creek Co. Colo., Aug. 8, 1985. Preoviposition 10:37 on T. divaricarpa leaf, Green Mtn., Jefferson Co. Colo., June 3, 1986. Oviposition 13:03 on top of T. divaricarpa leaf, NE Mt. Judge, "10,000'", Clear Creek Co., Colo., Aug. 5, 1987. Ovipositions 11:35, 11:37, 11:39, 11:41 on upperside and underside of T. divaricarpa leaves; female drummed Symphoricarpos leaves twice but did not lay; Coal Creek, Jefferson Co. Colo., July 15, 1991. Oviposition 10:33 on leaf upperside of Astragalus adsurgens var. robustior (W), Shingle Creek, "8000'", Jefferson Co. Colo., July 23, 1984. Oviposition 9:40 on underside of leaf of A. a. var. robustior (very common, must be the main host here, as T. divaricarpa is rare), Guy Hill, Jefferson Co. Colo., June 25, 1986. Oviposition 11:27 A. a. var. robustior leaf top, Guy Hill, Jefferson Co. Colo., June 22, 1992. Adults associated with A. adsurgens, 1/2 mi. N Silverthorne, Summit Co. Colo., July 3, 1989. Adults associated with A. a. var. robustior (purple-flowered var.), River Bend, Elbert Co. Colo., Aug. 7, 1989. Oviposition Astragalus alpinus (W), Keystone Gulch, Summit Co. Colo., Aug. 6, 1977. In the Colo. Front Range, T. divaricarpa is evidently a preferred host in the foothills, it and A. adsurgens var. robustior are both popular in montane habitats, and A. alpinus and no doubt others are eaten in the subalpine. Lupinus is evidently not often eaten. EGG cream, turning dull red-orange but only in the fattest part of egg (basal and distal quarters remain yellow-cream, a unique character apparently as other Colias eggs turn uniformly reddish). 3RD-STAGE-LARVA green, middorsal line dark-green, lateral band yellowish-green; head olive-green.

Colias alexandra or philodice. 2 eggs on Thermopsis divaricarpa leaves, Box Elder Creek, Elbert Co. Colo., May 26, 1991.

Colias occidentalis Scud. Adults assoc. with Lotus crassifolius (M), 1 mi. E Cedar Cgd., Colusa Co. Calif., July 8, 1974.

Colias eurytheme Bdv. Oviposition 13:30 on Trifolium repens leaf, Lakewood, Jefferson Co. Colo., Aug. 31, 1980. Oviposition 12:00 on upperside of T. repens (W) leaf, E of Tinytown, Jefferson Co. Colo., July 30, 1978. Oviposition T. repens, Boulder, Boulder Co. Colo., June 10, 1977. Ovipositions 12:21 and 12:22 on top of T. repens leaves (nearby Trifolium pratense was ignored by the female), Critchell, Jefferson Co. Colo., Aug. 3, 1985. Oviposition 11:05 on top of T. repens leaf, 1 mi. NW Brighton, Adams Co. Colo., Sept. 2, 1984.

oviposition 17:01 on top of T. repens leaf, 2.5 mi. NE Conger, Freeborn Co., Minn., June 18, 1986. Oviposition 11:43 on top of T. repens leaf, Tinytown, Jefferson Co. Colo., July 22, 1987. Oviposition 10:55 on T. repens leaf top; Lakewood, Jefferson Co. Colo., Oct. 5, 1990. Oviposition 10:35 T. repens leaf top, egg found on Lupinus argenteus (blue-flowered var.) leaf top, Tinytown, Jefferson Co. Colo., June 17, 1992. Oviposition Trifolium nanum (G), Hermit Pass, Custer Co. Colo., July 1970. Oviposition 13:32 on top of Trifolium hybridum leaf; Tinytown, Jefferson Co. Colo., June 26, 1990. Albino oviposited 11:00 T. hybridum leaf top, orange female ovip. 11:14 edge of T. hybridum leaf (2-cm plant horribly mangled by car tires on dirt road), ovip. 11:15 Astragalus flexuosus shriveled leaflet, albino ovip. 11:58 A. flexuosus leaflet (leaflet and leaf badly chewed by some insect), Tinytown, Jefferson Co. Colo., June 16, 1992. Ovipositions 12:26 & 13:51 on top of Trifolium fragiferum leaves, Barr Lake, Adams Co. Colo., Aug. 27, 1988. Ovipositions 10:40, 10:40 on top of T. fragiferum leaves, Barr Lake, Adams Co. Colo., Sept. 6, 1988. Oviposition 9:49 T. fragiferum leaf top, Lakewood, Jefferson Co. Colo., July 12, 1991. Oviposition 13:15 on top of Glycyrrhiza lepidota Pursh leaf, Chimney Gulch, Jefferson Co. Colo., July 10, 1978. Ovipositions 13:47, 13:48 on top of G. lepidota leaves, Wheatridge, Jefferson Co. Colo., July 11, 1989. Oviposition 2 eggs on Medicago sativa, Lakewood, Jefferson Co. Colo., June 10, 1977. Oviposition M. sativa, Lakewood, Jefferson Co. Colo., June 18, 1977. 3 larvae swept from M. sativa (1 with wide subdorsal band reared to adult C. eurytheme, 1 parasitized, 1 with narrow subdorsal band reared to adult hybrid C. eurytheme X C. philodice), Cherry Creek Res., Arapahoe Co. Colo., Aug. 13, 1985. Larva (with slight subdorsal yellow line in addition to the broader lateral yellow line) found on M. sativa, W Medicine Lodge, Barber Co., Kans., Sept. 4, 1986. Larva with strong subdorsal yellow line (as well as lateral line) found on M. sativa, reared to form alba female, NE of Conger, Freeborn Co., Minn., June 20, 1987. 1 larva found on M. sativa (had yellow subdorsal line, white lateral band) later died, Cherry Gulch, Jefferson Co. Colo., Aug. 17, 1987. 2 older larvae (subdorsal line very faint on male larva, weak on female larva) swept from M. sativa leaves reared to adults, Barr Lake, Adams Co. Colo., Sept. 6, 1988. Oviposition 10:25 Medicago lupulina, Five Points Recreation Area, Fremont Co. Colo., Aug. 2, 1973. Two ovipositions 9:45 on top of leaves of mature M. lupulina, Valdez, Taos Co. New Mex., May 24, 1985. Oviposition 14:04 on top of leaf of M. lupulina seedling, Taos Ski Area, Taos Co. New Mex., May 24, 1985. 1 egg found (reared to adult female emerged Nov. 14, 1989), 1 collapsed egg (possibly Colias philodice) found on leaves, 1 2nd-stage larva (possibly C. philodice) found (wasps emerged from), all on M. lupulina (eggs on leaf upperside), N Bear Creek Lake, Jefferson Co. Colo., Oct. 7, 1989. Half-grown larva found on ground below M. lupulina, reared emerged July 26, N fork Clear Creek, Gilpin Co. Colo., July 11, 1991. Oviposition Melilotus officinalis (G), 3 mi. SW Beulah, Pueblo Co. Colo., July 26, 1970. Egg found on M. officinalis leaf top, reared to adult; N Bear Creek Res., Jefferson Co. Colo., Oct. 4, 1990. Oviposition 9:26 on top of Melilotus alba leaf, Devil's Gulch, Jefferson Co. Colo., July 24, 1987. Female form alba preoviposition 8:45 M. alba, Wheatridge, Jefferson Co. Colo., July 13, 1988. Oviposition 11:15 on M. alba leaf upperside, landed on G. lepidota leaves 4X but did not lay; Wheatridge, Jefferson Co. Colo., July 26, 1990. One female oviposited M. alba leaf tops 11:00, 11:10, 11:11, 11:17, 11:18, 11:24, 11:32; from 10:58-11:32 she also ignored some M. alba, fed on M. sativa flowers 8X but did not lay, fed on T. pratense flowers and drummed and left a leaf of one, landed on T. fragiferum but did not lay, ignored T. hybridum, ignored Thermopsis divaricarpa ~4X; Wheatridge, Jefferson Co. Colo., Aug. 11, 1990. Oviposition 11:10 on top of M. alba leaf, she ignored T. pratense; Wheatridge, Jefferson Co. Colo., Aug. 13, 1990. Oviposition (by form alba female) 11:04 M. alba leaf top, SW Albert Lea, Freeborn Co. Minn., June 21, 1991. Oviposition 13:42 Lupinus argenteus (white flowered var. with no banner spot, glabrous plane leaves) (not ssp. ingratus which has white flowers but has banner spot and glabrous folded leaves) leaflet top; Tinytown, Jefferson Co. Colo., June 21, 1990. Bent abdomen to L. argenteus (white flowered var. with no banner spot, glabrous plane leaves) but no egg laid; Tinytown, Jefferson Co. Colo., June 28, 1990. Oviposition 12:26 (the female apparently a hybrid with philodice, because not as much orange as usual) on top of L. argenteus leaf, Chief Hosa Lodge, Jefferson Co. Colo., July 28, 1987. Oviposition 12:37 on top of L. argenteus leaf, ovipositions 12:42 and 12:45 on top of Astragalus agrestis ("dasyglottis") (W) leaves, all Shingle Creek, Jefferson Co. Colo., July 24, 1984. Oviposition Astragalus bisulcatus, Central Plains Experimental Range, Weld Co. Colo., June 1976, J. Scott and David L. Wagner. Adults associated with A. bisulcatus, W Soda Lakes, SE Morrison, Jefferson Co. Colo., Sept. 10, 1987. Ovipositions 13:46, 13:49 on side of

leaflets of young shoots in center of senesced A. bisulcatus, Bandimer Speedway NE Morrison, Jefferson Co. Colo., Sept. 22, 1987. Oviposition 11:30 Astragalus whitneyi (M), Sonora Pass, Mono Co. Calif., Aug. 25, 1974. Oviposition Astragalus drummondii (W), 2 mi. N Garden of the Gods Road, El Paso Co. Colo., June 7, 1981. Oviposition 13:30 on upperside of leaf of Astragalus flexuosus (W), E of Tinytown, Jefferson Co. Colo., July 30, 1978. Ovipositions 10:12, 11:15, 12:55, 12:56 on A. flexuosus (W), Chimney Gulch, Jefferson Co. Colo., July 10, 1978. Oviposition 15:20 on top of A. flexuosus leaf, Filius Park, Jefferson Co. Colo., Aug. 3, 1984. 4 eggs laid 11:50-11:55 on top of A. flexuosus leaves, Genesee Park, Jefferson Co. Colo., Aug. 5, 1984. 9 eggs laid 10:33-11:19 on top of leaves of 9 small (5-10 cm tall) plants of A. flexuosus, Genesee Mtn., Jefferson Co. Colo., Aug. 8, 1984. Ovipositions 10:24 and 10:26 on top of A. flexuosus leaves, O'Fallon Park, Jefferson Co. Colo., Aug. 13, 1984. Oviposition 11:58 on top of A. flexuosus leaf, Red Rocks, Jefferson Co. Colo., June 15, 1987. Oviposition 10:14 A. flexuosus leaf top, Tinytown, Jefferson Co. Colo., June 11, 1992. Oviposition 12:42 on A. flexuosus leaf top, Mt. Vernon Canyon, Jefferson Co. Colo., June 15, 1992. Oviposition 10:42 A. flexuosus leaf top, Guy Hill, Jefferson Co. Colo., June 22, 1992. Oviposition 13:55 A. flexuosus leaf top, Crawford Gulch, Jefferson Co. Colo., June 23, 1992. Ovipositions 11:24, 11:53, 11:55, 11:57, 11:57, on A. flexuosus (4 eggs on top of leaflets, 1 on side), she ignored Astragalus adsurgens var. robustior and L. argenteus plants, Guy Hill, Jefferson Co. Colo., June 27, 1988. Oviposition 9:27 on top of A. flexuosus leaf, White Ranch Park, Jefferson Co. Colo., July 3, 1988. Oviposition 11:06 on A. flexuosus leaf top; Tinytown, Jefferson Co. Colo., July 2, 1990. Oviposition 15:14 on A. flexuosus leaf top; Chimney Gulch, Jefferson Co. Colo., July 26, 1990. Oviposition 12:03 on A. flexuosus leaf top, albino female preovip. 12:00 A. flexuosus, Tinytown, Jefferson Co. Colo., July 3, 1991. Oviposition 11:40 on top of Astragalus parryi (W) leaf, Corwina Park, Jefferson Co. Colo., July 3, 1986. Oviposition 13:41 on young leaflet top of A. parryi, she ignored 4 A. parryi and 2 A. flexuosus plants before laying; NE Crawford Gulch, Jefferson Co. Colo., June 20, 1990. Oviposition 13:11 on Sphaerophysa salsula leaf top, of 8-cm-tall heavily-eaten seedling; 5 mi. N Moffat, Saguache Co. Colo., Aug. 22, 1990. Oviposition 9:41 on Vicia exiguua (W), W Tijeras, Bernalillo Co. New Mex., May 26, 1985. Oviposition 11:00 on top of leaf of juvenile Thermopsis divaricarpa, NW Lyons, Boulder Co. Colo., July 10, 1985. Preoviposition 10:26 but would not oviposit on T. divaricarpa, Coal Creek, Jefferson Co. Colo., July 17, 1991. Oviposition 15:00 on underside of leaf of probably Amorpha (W), S. Hopeton, Woods Co. Okla., Sept. 3, 1986. Females evidently oviposit on most herb legumes, except for Oxytropis and Psoralea. Despite several ovipositions on Lupinus, it is probably not preferred. Females generally place eggs on upperside of leaves, as in other Colias. EARLY STAGES (Colo.): EGG yellowish cream, turning orange after a day. FIRST-STAGE LARVA light yellow (1 larva olive-green), gradually becoming greenish-yellow toward the head after feeding, with short pale setae; head black with short cream setae. MATURE LARVA green, a white lateral band (with a red line down the middle), sometimes a subdorsal yellow-white line which may also have a red line down the middle; head green. Larvae take ~22 days in lab. PUPA green or light green, a blue-green or weak dark-green middorsal band, a lateral band from head horn to cremaster consisting of dark-green above yellow (or rarely cream, sometimes with orangish in middle of pale band on abdomen), sometimes a cream or yellow subdorsal line from T2-abdomen, a maroon subventral dash on A4, A5, A6 (small on A6) and spiracles blackish on these segments, wing veins yellowish, a dark marginal dot between ends of wing veins; the first sign of emergence is when the antenna, wing fringe, and middle areas of the wing turn pinkish. Larvae and pupae (reared to adults) have a lateral yellow (rose-centered except on some pupae) band and sometimes a subdorsal yellow (often rose-centered) band; the extent of the subdorsal band varies, as in C. philodice. Pupa takes ~9 days in lab. Lab immatures do not diapause. Persistent reports claim that C. eurytheme is merely a migrant to Colorado and to N U.S., migrating north in spring and being killed by fall freezes, whereas philodice is a native, but I believe that both are native, and there are no differences in habitat preference or flight periods between them. If eurytheme were a migrant, one would expect the native philodice to be better adapted to possible freezes, but both species fly in late October on the plains when freezes are frequent, as well as in April. They must be able to survive freezes, because 5 eurytheme adults (1 spring form, 4 summer form) were found at Barr Lake, Adams Co. Colo., Oct. 21, 1989, right after a 24°F freeze on Oct. 15-16. I have never seen migrating C. eurytheme, I have proof that C. eurytheme survives freezes, so I believe that C. eurytheme migration is rare. Other persons have seen rare migrations, but it is not a regular migrant.

Colias philodice or eurytheme. Egg found on top of Trifolium fragiferum leaflet, Barr Lake, Adams Co. Colo., Sept. 28, 1987. 3 eggs found on Astragalus bisulcatus leaf tops; N Bear Creek Res., Jefferson Co. Colo., Oct. 4, 1990. Pupa (prob. eurytheme) found 10 cm up on grass leaf, near Melilotus, Astragalus parryi, & Psoralea tenuiflora; N Oak Creek Cgd., Fremont Co. Colo., Sept. 11, 1990. Egg (philodice or eurytheme or alexandra) found Trifolium pratense leaf underside; Fraser, Grand Co. Colo., Aug. 1, 1990. 1 red egg found on Astragalus shortianus leaflet (larva died in lab), S. Table Mtn., Jefferson Co. Colo., May 30, 1991.

Colias eurytheme X philodice. . Oviposition (female fw 1/3 orange) 11:19 Medicago sativa leaf upperside, Wheatridge, Jefferson Co. Colo., July 31, 1991.

Colias philodice philodice God. Oviposition 10:45 on top of Trifolium repens leaf, jct. hwy. 76 and 120th St., Adams Co. Colo., Sept. 8, 1984. Oviposition 9:32 on top of T. repens leaf; Lakewood, Jefferson Co. Colo., July 6, 1990. Oviposition Trifolium sp., Ophir Creek, Custer Co. Colo., July 6, 1973. Form alba oviposition 13:55 on top of Trifolium fragiferum leaf, preoviposition 11:30 on top of T. fragiferum leaf, 7 older larvae (subdorsal line orange on 1 male larva, weak on 1 female, very faint on 2 males 3 females) swept from Medicago sativa leaves reared to adults, Barr Lake, Adams Co. Colo., Sept. 6, 1988. Oviposition 10:37 on underside of M. sativa (alfalfa) leaf, Montezuma Can. 14 mi N Camp Cottonwood, San Juan Co. Utah, Aug. 25, 1977. Larva swept from M. sativa reared to adult, Canon City, Fremont Co. Colo., July 30, 1985. 2 larvae (with subdorsal yellow band absent, or thin and faint) swept from M. sativa (1 reared to adult, 1 died), Cherry Creek Reservoir, Arapahoe Co. Colo., Aug. 13, 1985. Adults associated with M. sativa; Barr Lake, Adams Co. Colo., Sept. 8, 1990. C. philodice is common in M. sativa fields in Colo., Utah, and Nev. Oviposition 11:42 Medicago lupulina; N Greenland, Douglas Co. Colo., July 19, 1990. Oviposition 13:25 on M. lupulina leaf top; N Bear Creek Res., Jefferson Co. Colo., Oct. 1, 1990. Oviposition Melilotus alba (G), 21 mi S Alpine, Texas, Sept. 20, 1970. Oviposition 9:35 on side of joint of M. alba seedling; oviposition 9:50 upperside of tiny leaflet of M. sativa seedling 2 cm tall; Wheatridge, Jefferson Co. Colo., July 14, 1990. Oviposition Thermopsis divaricarpa, Green Mtn., Jefferson Co. Colo., June 30, 1972. Oviposition Astragalus miser var. oblongifolius (W), Saguache Park 11000', Saguache Co. Colo., June 24, 1971. Oviposition Astragalus adsurgens (W), 2 mi. NE Rosita, Custer Co. Colo., July 1970. Oviposition 15:25 on top of A. adsurgens var. robustior leaf, Filius Park, Jefferson Co. Colo., Aug. 3, 1984. Oviposition 11:06 on top of A. a. var. robustior leaflet; Chief Hosa Lodge, Jefferson Co. Colo., Sept. 3, 1990. Oviposition 11:30 on side of leaflet of Astragalus flexuosus, Green Mtn., Jefferson Co. Colo., July 16, 1984. Oviposition 12:09 on top of A. flexuosus leaf, Tinytown, Jefferson Co. Colo., July 21, 1984. Oviposition 11:30 on top of leaf of A. flexuosus, Falcon County Park, Jefferson Co. Colo., July 28, 1984. Oviposition 10:56 on top of A. flexuosus leaflet, Corwina Park, Jefferson Co. Colo., Aug. 27, 1984. Oviposition 13:00 on top of A. flexuosus leaf (and 7 eggs of C. philodice or C. eurytheme found on other A. flexuosus plants), Green Mtn., Jefferson Co. Colo., Sept. 14, 1985. Oviposition 11:40 on very young A. flexuosus leaf, and oviposition 11:44 on top of young A. flexuosus leaf, Green Mtn., Sept. 19, 1985. Oviposition 10:50 on underside of A. flexuosus leaf, Green Mtn., Jefferson Co. Colo., Sept. 11, 1986. Oviposition 9:32 2 eggs on top of A. flexuosus leaves, Indian Gulch, Jefferson Co. Colo., July 22, 1987. Preoviposition 13:35 on A. flexuosus but no egg found, Green Mtn., Jefferson Co. Colo., May 13, 1986. Oviposition 11:59 on A. flexuosus leaflet, S. Table Mtn., Jefferson Co. Colo., May 30, 1991. Oviposition 12:57 on side of A. flexuosus leaf, Apex Gulch, Jefferson Co. Colo., Sept. 5, 1991. Oviposition 13:13 on top of leaf of young Astragalus bisulcatus, Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 9, 1987. Ovipositions 9:32, 10:04, 10:11, 12:02, on young 3-cm-tall green sprouts in center of old senesced A. bisulcatus (the plants fruit and then senesce, and new sprouts grow from the roots, so this is an important fall host), W Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 10, 1987. Preoviposition 13:40 on green shoots in center of A. bisulcatus, Bandimere Speedway NE Morrison, Jefferson Co. Colo., Sept. 22, 1987. Oviposition 10:00 Astragalus agrestis leaflet top; Horsetooth Res., Larimer Co. Colo. May 23, 1990. Oviposition 12:19 on A. agrestis leaflet, Green Mtn., Jefferson Co. Colo., May 27, 1991. Oviposition 12:30 on Hedysarum boreale (W) leaf, bluff E Hayden, Routt Co. Colo., May 27, 1978. Adults associated with Sphaerophysa salsula (W) (the only possible hostplant seen), 9.7 mi. S. junction highways 285 and 17, Saguache Co. Colo., Aug. 17, 1986. 4 larvae (1, 1.5-2 cm long) found on S. salsula leaves, 1 male 1 female reared to adults; 5 mi. N Moffat, Saguache Co. Colo., Aug. 22, 1990. Females evidently oviposit on most herb legumes, except for Oxytropis and Psoralea; Lupinus is evidently seldom

chosen. There seems to be no difference in host specificity between C. philodice and C. eurytheme in Colo. Lab immatures do not diapause. Early stages (Colo.): EGG cream when laid. 1ST-STAGE LARVA olive-green with cream setae; head black with cream setae. MATURE LARVA green, a white lateral band (with a red line down the middle), sometimes a subdorsal yellow-white line which may also have a red line down the middle; head green. PUPA green, a weak dark-green middorsal band, a lateral band from head horn to cremaster consisting of dark-green above yellow (rarely white), sometimes a yellowish subdorsal line, a maroon subventral spot on A4, A5, A6 (small on A6) and spiracles blackish on these segments, wing veins yellowish, a dark marginal dot between ends of wing veins.

Colias pelidne minisni Bean (=skinneri Barnes). Oviposition Vaccinium sp. with 5 mm wide leaves (probably cespitosum), Round Lake, Wind River Mts., Wyo., Aug. 9, 1980. Adults often fly through slightly open forest (other Colias avoid forest) where this host grows.

Colias scudderii scudderii Reak. Oviposition 9:30 on small 4 cm juvenile Salix planifolia plant (immature of the very common .5 m tall shrub S. planifolia in valley bottoms there), Loveland Pass, Summit Co. Colo., July 17, 1977. Preovipositions 14:00 around juvenile plants of bog S. planifolia, Loveland Pass, Summit Co. Colo., July 27, 1978. Oviposition 13:29 leaf of 5 cm S. planifolia seedling, Loveland Pass, Summit Co. Colo., Aug 8, 1988. Preoviposition 13:00 near seedling S. planifolia, preoviposition 13:30 she landed on low bank with seedling S. planifolia, Salix reticulata nivalis, Viola labradorica (=bellidifolia), Vaccinium cespitosum; Loveland Pass, Summit Co. Colo., Aug. 7, 1990. Preoviposition 8:59 on Erigeron ursinus? under S. planifolia bush; oviposition 9:15 Vaccinium cespitosum leaftop of 4-cm-tall plant on open area (S. planifolia 40 cm away, V. cespitosum common nearby); oviposition 9:28 V. cespitosum leaftop of 3-cm-tall plant, in lush area a few m from S. planifolia; preoviposition 9:30 V. cespitosum; female landed 9:32 on S. reticulata nivalis; oviposition 9:37 on top of large leaf of ~5-7-cm tall V. cespitosum; oviposition 9:40 (same female as ovip. 9:28) leaftop of V. cespitosum 7 cm tall; oviposition 10:05 V. cespitosum leaftop of plant ~3 cm tall (V. cespitosum, Viola labradorica, & Polygonum viviparum common nearby); oviposition 10:40 (yellowish female) on top of Salix reticulata nivalis mature leaf (only S. r. nivalis and Thalictrum nearby); preoviposition 10:52 V. cespitosum; oviposition 11:49 V. cespitosum leaftop of 2 cm plant between S. planifolia bushes; Loveland Pass, Summit Co. Colo., Aug. 8, 1990. Oviposition 8:47 on side (underside) of tiny Vaccinium scoparium leaf (no other suitable hosts nearby); oviposition 11:09 V. cespitosum leaftop of 2-3 cm plant; oviposition 12:38 on top of 7-mm-long leaf of Polygonum viviparum seedling (P. viviparum 1, 2, 3, 4, 5, 5, cm etc. very common to 1 m, S. planifolia seedlings 5-8 cm tall 3, 4, 6, 7, 8, etc. common to 6 m, no Vaccinium within several m); same female oviposited 12:40 V. cespitosum leaftop of ~2-3 cm tall plant; 6 eggs found V. cespitosum leaftops; Loveland Pass, Summit Co. Colo., Aug. 9, 1990. HOSTPLANTS: Females prefer to oviposit in well-vegetated spots, just downslope of Salix bushes on low herbs 2-5 cm tall (esp. V. cespitosum bunches ~3-7 cm wide), especially where the arrangement of bushes funnels the flying female into a cul-de-sac; using this search image and the fact that eggs are laid on leaf uppersides allows one to find eggs in nature fairly easily. C. s. scudderii is evidently semi-polyphagous, the hosts being V. cespitosum (evidently most frequent), S. planifolia, S. r. nivalis, V. scoparium, P. viviparum. S. planifolia is the main willow in the subalpine willow bogs occupied by C. scudderii, so is undoubtedly a frequent hostplant (see also Boloria frigga, which eats it). Lab larvae ate Polygonum viviparum well, Vaccinium cespitosum well, Salix planifolia well, S. babylonica well, S. amygdaloides well, S. exigua some, Viola labradorica poorly, V. sororia affinis (=nephrophylla) ate 1 cm², refused Trifolium fragiferum. Lab immatures do not diapause. EARLY STAGES (Loveland Pass): EGG cream, turning orange-red after a day. FIRST-STAGE LARVA olive-green with white setae; head black with white setae. HALF-GROWN LARVA grass green, with a greenish-white lateral band, seta bases pale green; head grayer green. MATURE LARVA grass-green, a pale-green dot at base of each seta, with a lateral uniform-width band that appears yellow from far away (up close, the band is white but the white is replaced ventrally by a yellow-orange margin which is narrowest in intersegmental areas and widest in the middle of each segment), a faint subdorsal yellow-green line; underside and head grayer-green. PUPA green (yellowish-green on abdomen), a lateral yellowish band (consisting of cream color with orangish-yellow ventral half) running from A2 to side of cremaster, with a wide sublateral purplish-red dash on each of A4, 5, 6 and front of A7.

C. scudderii harroweri Klots. Adults in Wind River Mts. Wyo., like Colo. C. s. scudderii, are associated with .5-m-tall shrub willows in open valley

bottoms, and there is little if any difference between them ecologically; both can fly fast at times, though harroweri probably averages slower in speed. This ssp. will probably also prove to be semi-polyphagous.

Colias cesonia (Stoll). Oviposition 10:15 on Cassia? (1/2 m tall bush, with thousands of 2 X 5 mm grayish-green hispid leaflets, about 30 leaflets per leaf), Sycamore Can., Pima Co. Ariz., July 31, 1986.

Phoebis sennae (L.). Ovipositions 9:10, 9:11, 9:15 on Cassia (Senna) hirsuta var. leptocarpa (W) bush, and "20 eggs of either P. sennae or Eurema nicippe found on this bush, Pena Blanca Lake, Santa Cruz Co. Ariz., July 30, 1986. Ovipositions 10:02 on C. h. var. leptocarpa (W) bush, Sycamore Can., Pima Co. Ariz., July 31, 1986. Oviposition 8:50 on C. h. var. leptocarpa (W) bush, Peck Can., Santa Cruz Co. Ariz., Aug. 1, 1986. Oviposition 10:19 on Robinia sp. seedling with woody base, oviposition 10:26 on underside of inflorescence of C. h. var. leptocarpa (W), W of Pena Blanca Lake, Santa Cruz Co. Ariz., Aug. 5, 1986.

Eurema nicippe Cramer. Oviposition 9:10 on Cassia (Senna) hirsuta var. leptocarpa (W) bush, and "20 eggs of either E. nicippe or Phoebis sennae found on this bush, Pena Blanca Lake, Santa Cruz Co. Ariz., July 30, 1986.

Eurema proterpia Fabr. Oviposition 13:56 on seedling of thorny Prosopis glandulosa (= juliflora var. torreyana), 5 mi SE Patagonia, Santa Cruz Co. Ariz., Aug. 6, 1986.

Nathalis iole Bdv. 5 eggs laid 9:45-10:30 on 4-cm seedlings of Thelesperma megapotaemicum (W), 4 eggs laid 9:45-10:30 on 4-cm seedlings of Dyssodia papposa (W), but no eggs laid on Machaeranthera pinnatifida (W) or Ratibida columnifera (W) (all four are Asteraceae), all at Storrie Lake 6600', San Miguel Co. New Mex., Aug. 23, 1978. About 7 eggs found on top of leaves of D. papposa seedlings, 3 mi. E Vineland, Pueblo Co. Colo., Aug. 28, 1983. Ovipositions 11:18, 11:40 on top of upper leaves (near flowers) of large (6 cm tall) D. papposa plants, Cherry Creek Reservoir, Arapahoe Co. Colo., Sept. 3, 1987. 4 eggs found on edge of upper leaf, 1 egg found on phyllary, all on D. papposa, Bandimere Speedway NE Morrison, Jefferson Co. Colo., Sept. 18, 1987. 7 ovipositions 11:40-11:44 on 7 plants (on top of leaf, on phyllary, on underside of bract beneath head, on tail of seed, on top of phyllary below head, on edge of upper leaf, on edge of leaf below head), all on small Bidens frondosa plants, adults feed on the flowers very often also, Barr Lake, Adams Co. Colo., Sept. 8, 1987. Adults common associated with B. frondosa, Barr Lake, Adams Co. Colo., Aug. 30, 1987. 2 larvae (8 mm and 1 cm long) found resting head-downward on flower heads (they rest on these flower heads in lab also) of B. frondosa, eat phyllaries and part of upper leaves, reared to pupae, Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 9, 1987. B. frondosa has no egg mimics. Adults associated with Chaenactis douglasii (W), 9 mi. NW South Platte town, Jefferson Co. Colo., Sept. 1, 1977. D. papposa is the favorite host on grassland, B. frondosa the favorite host along lakes/creeks. EGGS MIMICKING PLANT GLANDS. D. papposa has elongate spots like the spots that are interpreted as egg-mimics on other Pieridae hostplants: each of the green phyllaries enclosing the flowers has 3-7 elongate 1.5 mm long orange-yellow (sometimes green) egglike ridges, and each leaf has 20-40 oval 1-mm-long orange-yellow translucent egglike spots that extend completely through the leaf; the leaf is pinnatifid, and each leaflet has one to several spots. These spots, called "glands" by botanists, apparently produce the plant's strong odor that gave the plant its common name "Fetid Marigold". Egg mimics are parts of plants that mimic the eggs of a phytophagous insect. A female attempting to lay an egg on the plant sees the egg mimic, is fooled into thinking that the mimic is a real insect egg, and the female does not lay an egg on the plant to avoid subjecting the hatching larva to competition resulting from an older larva hatching from the already-laid egg. Several examples are known. Heliconius females are deterred from laying by prior eggs, and egg mimics of Passifloraceae plants deter females from ovipositing (Williams & Gilbert 1981). Pieris sisymbrii lays fewer eggs on Brassicaceae hostplants already having eggs (Kellogg 1985), and egg mimics of Streptanthus (Brassicaceae) apparently deter P. sisymbrii females from ovipositing (Shapiro, 1981a). N. iole eggs are laid singly on phyllaries and upper leaves, and are ochre-yellow; the eggs do not change color to orange, unlike all other Pieridae eggs I am familiar with (Pieris, Pontia, Euchloe, Colias, etc.) which change color to orange. The fact that N. iole eggs are laid without hesitation on the plant parts which contain these egg mimics obviously proves the ineffectiveness of these egg mimics. The question therefore arises as to the purpose of these egg mimics. Population geneticists have shown that even a genetic trait that has a benefit of only 1% will spread through the population slowly, yet a benefit of 1% is too small to be proven in nature without great expense; so perhaps D. papposa egg mimics deter a small proportion

14 such as 1% of the eggs. Or perhaps the egg mimics originally were more successful in deterring Nathalis oviposition, but the butterflies adapted and are no longer fooled. But there is a more interesting explanation. D. papposa has a strong odor, vaguely similar to parsley or a mixture of mint and onion, that gives the plant the common name "Fetid Marigold" and supposedly emanates from these orangish spots, which are called "glands" by botanists; so perhaps these spots are not true egg mimics and have another (odor) function (perhaps the scent they produce repels ungulates or prairie dogs?). And, far from being deterred by the egglike odor glands, N. iole females oviposit readily on D. papposa and may even prefer it to other plants because the eggs are protected by the chemical defense of the plants against herbivores and perhaps some predators; predators would be repelled by the egglike glands, or would become habituated to regard the orangish-yellow egglike structures as inedible, so when the predator encounters an orangish-yellow N. iole egg the predator would think it is repulsive or inedible. The apparent proof that N. iole eggs are mimicking D. papposa glands, rather than D. papposa glands mimicking N. iole eggs, is that N. iole eggs are orangish-yellow like the glands, not orange as in other Pieridae eggs, and females lay freely on the gland-bearing plants. The origin of the plant glands needs to be considered. Perhaps the plants evolved them without influence from N. iole, but most plant glands are tiny and not colorful, so the glands possibly originally evolved as true egg-mimics, possibly orange in color, then after the egg-mimic function was lost the orange color lessened to orange-yellow and the N. iole eggs, now mimics of the glands, followed the color change to orangish-yellow. If D. papposa mimicked N. iole eggs, then the eggs and glands would be orange, the presumed ancestral color of the eggs. Immatures did not diapause in lab; freezes kill the species. EARLY STAGES from Colo.: EGG orangish-yellow, not changing color. MATURE LARVA green with numerous white hairs (& some black primary setae) on pointed bases, a short T1 collar containing two short dorsal red hills, a 0.6 mm wide maroon middorsal band edged by a 1/4 mm yellowish band containing green pointed seta bases (the maroon and especially the yellowish band narrowing on T2 & T1 and narrowest at collar), a 0.3 mm wide yellow band containing spiracles is edged above by a 0.3 mm wide maroon band, A10 has a wide blunt slight tail; head green with many white setae, only 4 black eyes (the lowest smaller). PUPA green with whitish minute sinuous markings (except emergence flap and wings have minute whitish-green mottling), underside of abdomen whitish-green, a middorsal maroon line on T1-2, from T3-A8 a middorsal translucent-maroon-green band edged by a yellow band (the yellowish band extending forward weakly to rear of T2), A2-3 spiracles white with maroon cap, A4-8 spiracles in a yellow band, A4-8 spiracles with maroon cap above yellow band (a slight maroon spot in front of maroon cap of A4-7 spiracles), orbit translucent-greenish-white, larval eyes marked by 4 whitish-green bumps, sulcus behind vertex dark green and edged posterolaterally on T1 by slight-reddish-tinged-cream, wing veins slightly whitish, no horn on head, proboscis extends to wing tips but covered by wings just beyond antenna, abdomen only moves at joints A4-5 and A5-6, pupa attached by cremaster and by silk girdle looped over A1.

Pierinae

Anthocharis sara sara Lucas. Oviposition Capsella bursa-pastoris, Monticello Dam, Yolo Co. Calif., March 18, 1972. Oviposition Arabis (Boechea) perennans, Sabino Can., Pima Co., Ariz., March 21, 1969. Two records are not valid hostplant records because of dubious identification: Egg (could be A. sara? or Pieris sisymbrii? or perhaps even P. napi?) found on stem halfway up plant of Descurainia sp. probably richardsoni, SW Hot Sulfur Springs, Grand Co. Colo., June 24, 1989. 1 egg (Anthocharis sara or Euchloe ausonia) found 2/3 way up from base to top of Arabis (Boechea) drummondii plant, Caribou bog, Boulder Co. Colo., July 2, 1989.

Euchloe hyantis hyantis (Edw.). Oviposition on Streptanthus tortuosus (M), Loon Lake, El Dorado Co. Calif., June 9, 1974. 3 eggs (female possibly Euchloe ausonia?) laid on Arabis sp., Glen Alpine Falls, El Dorado Co. Calif., June 3, 1972.

Euchloe ausonia ausonides Lucas (=coloradensis [Edw.], a weak ssp.). 8 larvae on Arabis (Turritis) glabra, Green Mtn., Jefferson Co. Colo., June 12, 1980. 15 larvae on A. glabra, Red Rocks, Jefferson Co. Colo., most larvae on siliques (=pods) but a few larvae eating upper leaves when the siliques were dry, June 27, 1980. 4th stage larva A. glabra inflorescence, Apex Gulch, Jefferson Co. Colo., July 3, 1984. 2 mature larvae on A. glabra siliques, Tinytown, Jefferson Co. Colo., July 21, 1984. 4 larvae (2nd-5th stages) on A. glabra inflorescences, Red Rocks, Jefferson Co. Colo., June 20, 1984. Larva on A.

glabra silique, Green Mtn., Jefferson Co. Colo., June 7, 1985. 5 larvae on siliques and one on upper leaf of A. glabra, Green Mtn., June 8, 15, 19, 1985. Oviposition 11:25 on juvenile Arabis probably glabra flower bud, about 10 other orange eggs found on A. glabra plants with developed siliques, Green Mtn., Jefferson Co. Colo., May 10, 1986. 3 larvae found on A. glabra pods of 3 plants, Green Mtn., Jefferson Co. Colo., June 9, 1986. 2 eggs found on A. glabra flower buds, Indian Gulch, Jefferson Co. Colo., April 30, 1988. 2nd stage larva on lower A. glabra silique, Red Rocks, Jefferson Co. Colo., May 25, 1988. Oviposition 10:00, another egg and 2nd stage larva found, all on A. glabra flower buds, Tinytown, Jefferson Co. Colo. June 2, 1988. 1 egg found on A. glabra flower bud, Falcon County Park, Jefferson Co. Colo., June 6, 1988. 3 eggs on flowers were probably E. ausonia, 2 eggs on leaves near top of plant were possibly E. ausonia, all on A. glabra, Tinytown, Jefferson Co. Colo., June 2, 1989. 2 eggs found on A. glabra flower buds, Tinytown, Jefferson Co. Colo., June 6, 1989. 2 eggs found on A. glabra flower buds, Tinytown, Jefferson Co. Colo., May 21, 1992. 2 orange eggs found on A. glabra flower buds, Tinytown, Jefferson Co. Colo., May 21, 1992. ~7 eggs found on A. glabra flower buds, 3 eggs found on Barbarea orthoceras flower buds, Lookout Mtn., Jefferson Co. Colo. May 30, 1988. Oviposition 15:50 B. orthoceras flower buds; Apex Gulch, Jefferson Co. Colo., June 18, 1990. ~11 larvae found on A. glabra siliques, 1 half-grown larva found on Sisymbrium altissimum silique, Green Mtn., Jefferson Co. Colo., June 21, 1988. Oviposition Arabis (Arabis) hirsuta (W), Red Rocks, Jefferson Co. Colo., June 6, 1978. Oviposition 12:00 between flower buds of A. hirsuta var. pycnocarpa, Ralston Buttes, Jefferson Co. Colo., May 29, 1988. Egg found on A. h. var. pycnocarpa flower bud, N Alma, Park Co. Colo., July 1, 1988. Mature larva on Arabis (Boechera) drummondii silique, Tinytown, Jefferson Co. Colo., July 2, 1980. 6 eggs found on A. drummondii, 1 egg found on A. glabra, 1 egg found on B. orthoceras, all on flower buds, Henderson Mine, Clear Creek Co. Colo., July 2, 1988. About 20 eggs and larvae found on A. drummondii inflorescences, Red Rocks, Jefferson Co. Colo., May 22-23, 1977. 3 eggs on A. drummondii flower pedicels, Tinytown, Jefferson Co. Colo., June 8, 1989. Two 5-mm larvae found on siliques, 1 egg found on flower buds, all on A. drummondii, Phillipsburg, Jefferson Co. Colo., June 17, 1989. 4 eggs found on A. drummondii flower buds, Caribou bog, Boulder Co. Colo., July 2, 1989. Egg (probably Euchloe ausonia) found on B. orthoceras flower bud, Apex Gulch, Jefferson Co. Colo., May 6, 1988. Oviposition 14:24 B. orthoceras flower bud, Tinytown, Jefferson Co. Colo., June 3, 1988. 2 eggs found on B. orthoceras flower buds, Loveland Pass, Summit Co. Colo., July 22, 1988. Egg found on B. orthoceras flower bud, Loveland Pass, Summit Co. Colo., Aug 2, 1988. Oviposition 14:00 and 3 other eggs found, all on terminal flower buds of B. orthoceras, Tinytown, Jefferson Co. Colo., May 26, 1984. 1 egg probably of Euchloe ausonia found on Lepidium (Neolepia) campestre flower bud, Lookout Mtn., Jefferson Co. Colo., May 30, 1988. 2 eggs found on L. campestre flower buds, oviposition 10:12 on B. orthoceras flower bud, 4 eggs found on B. orthoceras flower buds, Tinytown, Jefferson Co. Colo., May 17, 1988. 1 egg found on Lepidium virginicum flower bud, Guy Hill, Jefferson Co. Colo., June 14, 1988. 1 egg found on L. virginicum flower bud, 4 eggs found on B. orthoceras flower buds, 13 eggs found on A. glabra flower buds and leaves within 5 cm of top of plant, Tinytown, Jefferson Co. Colo., June 1, 1988. Oviposition 9:38 on Sisymbrium officinale, E end South Table Mtn., Jefferson Co. Colo., May 27, 1980. Oviposition 11:39 S. altissimum, Green Mtn., Jefferson Co. Colo., June 12, 1980. Two eggs on inflorescence and on lower leaf of small plant of S. altissimum, Apex Gulch, Jefferson Co. Colo., June 21, 1984. 3 eggs found on S. altissimum flower buds, Guy Hill, Jefferson Co. Colo., June 9, 1988. 3 eggs found on S. altissimum flower buds, Mt. Zion, Jefferson Co. Colo., June 29, 1989. 2 eggs found on S. altissimum flower buds, 1 2nd-stage larva found on A. hirsuta var. pycnocarpa silique, N fork Clear Creek, Gilpin Co. Colo., June 14, 1989. Oviposition 12:36 Draba nemorosa flower bud, Van Bibber Creek, Jefferson Co. Colo., May 26, 1988. 3 eggs found on Berberoa incana flower buds, 1 egg found on A. glabra flower bud, W Idledale, Jefferson Co. Colo. June 6, 1988. Pupae hibernate. EGG bluish-cream, soon turning orange. FIRST-STAGE LARVA light-ochre-yellow with black setae; head chitin brown. MATURE LARVA bluish-gray (dark to light in different individuals)(with darker mottling than Euchloe olympia, so appearing darker with less blue), with many small to large black seta bases (primary setae have large seta bases and some other setae do also), body with half as many long setae as E. olympia because most of the long setae with small bases of E. olympia are absent, so that dorsal pinaculi are twice as wide as E. olympia on the average, middorsal pale line on T1-2, a dorsolateral yellow band (sometimes orangish-yellow or slightly-greenish yellow)(green with yellowish areas in E. olympia), a lateral white band the lower half of which is yellow (the yellow is interrupted

in E. olympia), underside pale bluish-gray, prolegs greenish-cream; head greenish-gray (pale blue-gray in E. olympia), the lateral pale body band sometimes extends onto rear of head very slightly, with numerous tiny and large black seta bases except on frontoclypeus, middorsal notch has few black seta bases, eye bases black. PUPA tan, with small blackish dots (small midventral spots on A5-6, a row of tiny dots beside middorsal band, a row of small dots above lateral band, another row of tiny dots below it, a subventral row of tiny dots), a long dark-brown cone on head (sometimes tipped with orange-brown), a narrow dark-brown middorsal band, a wide dark-brown lateral band (from head cone to inner margin of wing to cremaster), wings have dark-brown streaks between veins.

Euchloe ausonia ausonides Lucas. Eggs on inflorescence of Brassica nigra, Briones Park, Contra Costa Co. Calif., March 19, 1970. Oviposition B. nigra inflorescence, Berkeley Marina, Contra Costa Co. Calif., June 1970. Several hundred ovipositions (recorded times 9:17, 9:29, 10:05, 10:10, 10:12, 10:24, 10:29, 10:34, 10:41, 10:59, 11:11, 11:38, 12:21, 13:22, 14:13, 14:15, 14:36, 15:09), eggs, and larvae, all found on B. nigra, larvae raised to adults on B. nigra, Point Richmond, Contra Costa Co. Calif., April-June 1970; eggs are laid singly in the middle of the unopened flower buds, and if the plant has more than one such inflorescence, more eggs are laid on the terminal than on lower inflorescences; females almost always lay only a single egg per plant, then fly at least 3 meters or so (usually much farther) before laying another; plants usually had one to several eggs, but one plant had 10; larvae eat the flowers and growing fruits. Three ovipositions and eggs found on Raphanus sativus, Point Richmond, Contra Costa Co. Calif., April-June 1970. Scott (1975a) reports ecology and movements. EGG bluish-white when laid, turning orange after a day.

Euchloe ausonia ausonides or olympia. Eggs found on flower buds of Lepidium virginicum and Arabis sp. probably glabra, Green Mtn., Jefferson Co. Colo., May 4, 1986. Eggs found on flower buds of Arabis (Turritis) glabra (1 bluish-cream egg), L. virginicum (1 orange egg), Descurainia sp. probably sophia (1 orange egg), Green Mtn., Jefferson Co. Colo., May 18, 1986.

Euchloe olympia (Edw.). 1 larva found on Arabis (Turritis) glabra silique, Green Mtn., Jefferson Co. Colo., June 9, 1986. Oviposition 9:15 on A. glabra on leaf near top of plant, Green Mtn., Jefferson Co. Colo., June 12, 1980. Oviposition 12:25 A. glabra, Hogback at I-70, Jefferson Co. Colo., May 22, 1980. Egg found on A. glabra, Wildcat Mound, Douglas Co. Colo., May 25, 1980. Oviposition 11:22 A. glabra flower bud, Tinytown, Jefferson Co. Colo., June 3, 1988. Oviposition 10:22 Descurainia pinnata leaflet top, oviposition 9:35 Lepidium (Neolepia) campestre flower bud, 2 other eggs found on L. campestre flower buds, she landed on 2 Sisymbrium ?altissimum seedlings but did not lay, she fed on Lesquerella montana flowers 4 times but did not lay, eggs faintly bluish white when laid, cream 6 hours later, turning orange after a day, flats near Van Bibber Creek, Jefferson Co. Colo., May 26, 1988. Oviposition 11:40 on small plant of D. pinnata, SW end North Table Mtn., Jefferson Co. Colo., May 24, 1980. Oviposition 10:50 on flower bud of seedling Descurainia sophia, oviposition 10:55 on flower bud of partly mature D. pinnata (W), Green Mtn., Jefferson Co. Colo., May 4, 1986. Ovipositions on flower buds except as noted, at 11:30, 11:30, 11:35, 11:35, 11:37, 11:40, 11:45, 11:45, 11:45 (on leaf near flower buds), 11:47, 11:47, 11:47, 11:57, 11:57 (two eggs on one plant), 12:00, 12:01, 12:05, 12:08, 13:12, and 1 orange egg found on leaf near flower buds, all on tiny D. sophia plants with no fruits (2 large nearby plants with fruits det. D. sophia by W), all these ovipositions by just 2 females; ovipositions 12:17, 12:17, 12:20, 12:51, 12:51, on flower buds of Lepidium virginicum, and 2 orange eggs and 1 first-stage larva and 1 second-stage larva found on L. campestre; all Green Mtn., Jefferson Co. Colo., May 10, 1986. Seedling D. sophia and D. pinnata are difficult to distinguish; this site was later visited on July 2, 1986, when it seemed that most of the above plants used for oviposition, now mature, were D. pinnata though some were D. sophia. Oviposition 13:45 on flower bud of tiny D. sophia plant, Green Mtn., Jefferson Co. Colo., May 13, 1986. Oviposition 9:38 on top of flower bud of 60 cm mature Descurainia richardsonii (W) plant, Green Mtn., Jefferson Co. Colo., June 3, 1986. Descurainia spp. may be the most frequent hosts. Females often oviposit on hosts between shrubs on N-facing slopes, where Descurainia and Arabis are most common, but also oviposit wherever else the hosts grow. Neither Euchloe species silks the pods together as Pontia sisymbrii does. EGG faintly-bluish white when laid, cream 6 hours later, turning orange after a day. FIRST-STAGE LARVA pale; head chitin brown. MATURE LARVA blue-gray (lighter than Euchloe ausonia because olympia has paler mottling), with many tiny and some large black seta bases, the large ones being primary setae (SD1 largest, L1-2 almost as large, D1-2 smaller), body has more than twice as many long setae as E. ausonia (E. olympia has numerous setae with

tiny bases, E. ausonia few) so that dorsal pinaculi are half as wide as those of E. ausonia on the average, a pale blue middorsal line on thorax, a dorsolateral green band (this band yellow in E. ausonia) contains a greenish-yellow anterior area on each segment, front rim of T1 yellow dorsally, a white lateral band the ventral half of which is yellow (except on middle of each segment where it is white, and the yellow expands dorsally at segment joints to somewhat pinch out the white in the band), underside bluish-gray, the prolegs slightly greener; head pale blue-gray, with numerous tiny and large black seta bases except on frontoclypeus, middorsal notch lacks black seta bases, the pale lateral body band extends onto rear of head slightly, eye bases black. PUPA very similar to E. ausonia.

Pieris rapae (L.). Oviposition Arabis (Turritis) glabra, Plaskett Meadows, Glenn Co. Calif., June 29, 1974. One 4th-stage larva on A. glabra silique, oviposition 9:23 2 eggs on underside of Sisymbrium altissimum leaves, Green Mtn., Jefferson Co. Colo., June 21, 1988. Oviposition Brassica oleracea var. acephala, Lakewood, Jefferson Co. Colo., June 10, 1977. Larvae found in B. oleracea var. capitata (cabbage) by Laura Pestorius, 2 mi. NE Conger, Freeborn Co., Minn., June, 1986. Oviposition 10:50 Brassica nigra leaf top, oviposition 10:55, 10:56, 10:57, 10:59 on top of Brassica kaber leaves; SW Albert Lea, Freeborn Co. Minn., June 21, 1991. Ovipositions 10:35 & 10:37 under Brassica carinata (mis-labeled "Pak-Choi" on seed packet) upper leaves, Lakewood, Jefferson Co. Colo., May 30, 1992. Oviposition 8:50 on Lunaria annua silicle, Lakewood, Jefferson Co. Colo., June 21, 1981. Three ovipositions 11:30 on side of L. annua silicles, Lakewood, Jefferson Co. Colo., July 1, 1985. Oviposition 9:39 among Lepidium virginicum var. pubescens silicles, NE Conger, Freeborn Co. Minn., June 18, 1991. Oviposition 9:43 on underside of lower leaf of Lepidium (Neolepia) campestre seedling, Tinytown, Jefferson Co. Colo., May 17, 1988. Ovipositions 10:10, 10:10, on leaf tops, and 3 mature larvae found, all on L. campestre; 1 mature larva and 1 4th-stage larva found on Barbarea orthoceras; larvae usually rest on leaf petioles of low young plants, but one was on a rock eating a leaf tip; when touched larvae whip their body sideways; all Van Bibber Creek, Jefferson Co. Colo., Sept. 23, 1987. Oviposition 11:23 on top of B. orthoceras leaf, and 9 eggs found on same large leaf, NW Guy Hill, Jefferson Co. Colo., July 30, 1987. Oviposition 11:30 on underside of B. orthoceras leaf, Apex Gulch, Jefferson Co. Colo., July 3, 1984. Ovipositions 10:09, 10:10, 10:10, 10:45, and 3 other eggs found, on top of leaves of small plants growing in shade under old dead plants, one 1-cm larva found on leaf top of small plant, ovipositions 10:40, 10:40 on underside of seedling leaves (leaves only 6 mm wide), and 2 other eggs found on seedlings, all on B. orthoceras, Apex Gulch, Jefferson Co. Colo., Sept 3, 1988. 10 eggs and 4 first-stage larvae found on underside of B. orthoceras leaves, Chatfield Res., Jefferson Co. Colo., Sept. 27, 1988. Oviposition 10:30 two eggs on leaf underside, another egg found on leaf underside, all on B. orthoceras, Apex Gulch, Jefferson Co. Colo., July 15, 1989. Oviposition 10:58 on top of B. orthoceras seedling leaf, Apex Gulch, Jefferson Co. Colo., July 17, 1989. Egg found on B. orthoceras leaf top; Plum Creek, Sedalia, Douglas Co. Colo., Sept. 18, 1990. 2 larvae ~13 & 20 mm long found on B. orthoceras leaf undersides; N Bear Creek Res., Jefferson Co. Colo., Sept. 27, 1990. Egg found B. orthoceras leaf top, Tinytown, Jefferson Co. Colo., July 3, 1991. 2 eggs found on top of B. orthoceras, Apex Gulch, Jefferson Co. Colo., Sept. 5, 1991. Egg found on top of B. orthoceras leaf, N Bear Creek Res., Jefferson Co. Colo., Sept. 9, 1991. Oviposition 11:20 on B. orthoceras leaf underside, egg found on B. orthoceras leaf upperside, oviposition 9:30 on Cardaria ("Lepidium") latifolia under small leaf 50 cm up on a 70-cm-tall plant along creek, Apex Gulch, Jefferson Co. Colo., Aug. 24, 1989. Oviposition 9:34 on underside of leaf of juvenile Barbarea vulgaris (W), El Dorado Springs, Boulder Co. Colo., July 5, 1985. Oviposition 11:10 on underside of leaf of Cardaria pubescens, jct. hwy. 76 and 120th St., Adams Co. Colo., Sept. 6, 1984. Two ovipositions 13:00 on leaves of juvenile plants (growing as sprouts from the base of dead stalks) of C. pubescens, Canon City, Fremont Co. Colo., July 30, 1985. Oviposition 15:35 on underside of leaf of C. pubescens, Fort Lupton, Weld Co. Colo., Sept. 8, 1987. Oviposition 11:35 on leaf of juvenile Rorippa teres, Barr Lake, Adams Co. Colo., Aug. 17, 1985. Oviposition 13:42 on top of R. teres leaf, Barr Lake, Adams Co. Colo., Aug. 30, 1987. 4 half-grown to larger larvae found resting on top of R. teres leaves & stems, Barr Lake along canal, Adams Co. Colo., Oct. 11, 1989. Ovipositions 10:33, 10:35 on underside of leaves of upper part of plant, and an egg cluster of 3 eggs found on underside of leaf, all on Nasturtium officinale, Cherry Creek Res., Arapahoe Co. Colo., Aug. 23, 1986. Oviposition 10:53 on top of N. officinale leaf, Barr Lake, Adams Co. Colo., Sept. 2, 1987. Oviposition 10:48 on top of N. officinale leaf, Barr Lake, Adams Co. Colo., Sept. 8, 1987.

18 Ovipositions 10:08 on leaflet underside, 11:21 on tiny immature leaflet underside, both on N. officinale; Wheatridge, Jefferson Co. Colo., July 7, 1980. A 10-mm-long larva (reared to pupa) found under Cleome serrulata leaflet, Barr Lake, Adams Co. Colo., Sept. 5, 1989. A 12-mm-long larva found on C. serrulata leaf top (larva wiggles violently from side to side when picked up with tweezers, an anti-predation behavior), Barr Lake, Adams Co. Colo., Sept. 25, 1989. B. orthoceras grows on creek banks, and is the most frequent native hostplant in this area; many Brassicaceae are eaten in weedy areas, and cultivated cabbage etc. are commonly eaten in gardens. EGG yellowish-cream, turning orange-cream. FIRST-STAGE LARVA yellowish cream on body and head. MATURE LARVA green with tiny dark hair bases, a yellow-green narrow heart line, a lateral row of deep-yellow dashes; head green. PUPA usually green but some are brownish-gray, all with some tiny dots including between wing veins, a middorsal cream band (weak on front of abdomen, with orange-brown areas below protruding processes on middorsal crest of head and abdomen), a lateral cream band on abdomen and above wings (partly orange-brown above wings near pointed processes), proboscis tip blackish; browner pupae have more tiny dots and have blackish-tipped processes and have a blackish spot on middorsal band on front of each abdomen segment.

Pieris napi pallidissima (B. & McD.). This is probably a valid ssp., limited to W Colo.-Utah, characterized by very weak black markings and perhaps by multiple generations. Oviposition 11:00 and other eggs found on Nasturtium officinale (W) leaves, Unaweep Can., Mesa Co. Colo., Aug. 30, 1978 (this population is one of the few multi-generation populations in Colorado, all of which are at low altitude along creeks in W Colo.).

Pieris napi oleracea (Harris) (= mcDunnoughi Rem., a weak ssp.). Oviposition 11:30 on underside of leaf of Cardamine cordifolia, Fraser River, Grand Co. Colo., July 5, 1984. 2 eggs found on leaf underside halfway up C. cordifolia, Jefferson Creek, Park Co. Colo., June 23, 1988. Egg found on underside of C. cordifolia leaf, bog S Breckenridge, Summit Co. Colo., June 28, 1988. Egg found on underside of C. cordifolia leaf, Henderson Mine, Clear Creek Co. Colo., July 2, 1988. Egg found under C. cordifolia leaf, SW Hot Sulfur Springs, Grand Co. Colo., June 24, 1989. 2 eggs found under C. cordifolia leaf, Caribou bog, Boulder Co. Colo., July 2, 1989. Egg found on C. cordifolia leaf underside, Rabbit Ears Pass, Routt Co., Colo., July 7, 1989. C. cordifolia is obviously the main hostplant at higher altitudes; it is common along creeks, the only habitat for napi. EGG yellowish-cream. FIRST-STAGE LARVA cream, becoming green internally after feeding; head tan-cream.

Pontia chloridice beckerii (Edw.). Oviposition Stanleya pinnata (G), E of Penrose, Pueblo Co. Colo., Aug. 17, 1970. Eggs on S. pinnata inflorescence, 2 mi. W Frenchman, Churchill Co. Nev., June 2, 1972. Oviposition 13:40 Arabis (Boechera) lignifera, Avon, Eagle Co. Colo., May 29, 1983. Eggs on Cleome serrulata, 2 mi. SW Penrose, Fremont Co. Colo., Aug. 26, 1973.

Pontia protodice (Bdv. & LeC.). Oviposition 10:45 on Arabis (Boechera) drummondii (W) inflorescence, .6 mi. N of Moffat Tunnel, Grand Co. Colo., July 16, 1978. Oviposition A. drummondii (W), 1 mi. E Hopewell Lake Cgd., 9800', Rio Arriba Co. New Mex., June 21, 1978. Oviposition 10:30 on Sisymbrium altissimum (W), Chimney Gulch, Jefferson Co. Colo., July 10, 1978. Oviposition 8:20 on S. altissimum (W) inflorescence, Red Rocks, Jefferson Co. Colo., July 7, 1978. Oviposition 11:45 on S. altissimum (W) inflorescence, Chimney Gulch, Jefferson Co. Colo., July 1, 1978. Oviposition 12:35 S. altissimum (W) inflorescence, Green Mtn., Jefferson Co. Colo., June 30, 1978. Oviposition S. altissimum, Howard, Fremont Co. Colo., Aug. 13, 1973. Oviposition 15:50 on S. altissimum, Filius Park, Jefferson Co. Colo., Aug. 3, 1984. Two eggs on S. altissimum flower buds, Apex Gulch, Jefferson Co. Colo., June 18, 1985. Oviposition 12:15 on flower bud of young S. altissimum, Chief Hosa Lodge, Jefferson Co. Colo., July 28, 1987. 1 egg found on petiole below flower, 1 6-mm larva found on silique, 1 mature larva found on upper leaves, all on S. altissimum, Barr Lake, Adams Co. Colo., Aug. 23, 1988. Oviposition 10:00 2 eggs on Sisymbrium sp. flower buds & 3 older larvae found on inflorescences; oviposition 11:45 6 eggs on Nasturtium officinale flower buds; Wheatridge, Jefferson Co. Colo., July 20, 1991. Oviposition 8:30 Descurainia sophia (W), Mt. Zion, Jefferson Co. Colo., July 2, 1978. Oviposition D. sophia (G), Bear Creek, Fremont Co. Colo., June 29, 1970. Oviposition 10:30 on inflorescence of small plant of D. sophia, Mt. Zion, Jefferson Co. Colo., June 11, 1981. Oviposition 12:16 D. sophia, Green Mtn., Jefferson Co. Colo., June 8, 1985. Ovipositions 14:52 1 egg on underside of leaflet, 2 eggs found on separate flower pedicels, all on D. sophia plants, eggs light peach (orangish-cream) when laid, Guy Hill, Jefferson Co. Colo., June 24, 1988. Ovipositions 10:30, 10:36 on stems of 1 cm tall D. sophia seedlings, Van

Bibber Creek, Jefferson Co. Colo., Sept. 24, 1988. Oviposition 12:00 two eggs, and 4 other eggs found, all on D. sophia inflorescences, Lakewood, Jefferson Co. Colo., May 24, 1991. Ovipositions 11:35 & 11:36 leaf tops, 11:38 flower buds, all on D. sophia, Tinytown, Jefferson Co. Colo., June 17, 1992. Oviposition Descurainia pinnata, Crow, Pueblo Co. Colo., July 22, 1972. Oviposition 13:20 2 eggs on flower buds of Descurainia richardsonii viscosa; a 4th-stage larva found on Arabis drummondii inflorescence, Fraser, Grand Co., Colo., Aug. 5, 1991. Oviposition Thlaspi arvense (G. & det. J. Scott), Coal Dale, Fremont Co. Colo., July 10, 1971. Oviposition 8:23 Thelypodium wrightii oklahomensis (det. as T. elegans, W), Box Canyon, Fremont Co. Colo., May 27, 1972. Egg on Schoenocrambe linearifolia (W) flower bud, Caprock S of San Jon, Quay Co. New Mex., May 14, 1985. Oviposition 8:52 Wislizenia refracta (W), dunes 5 mi. N San Felipe Pueblo, Sandoval Co. New Mex., Sept. 9, 1977. Oviposition Cardaria draba (W), near Ridgway, Ouray Co. Colo., June 16, 1978. 5 eggs laid 10:35-10:41 on top of Cardaria pubescens leaves, 1 mi. NW Brighton, Weld Co. Colo., Sept. 2, 1984. Ovipositions 10:55, 11:02, and 12:35, and 4 other eggs found, all on top of leaves of C. pubescens, jct. hwy. 76 and 120th St., Adams Co. Colo., Sept. 2-8, 1984. 7 ovipositions ~15:18 on top of leaves of 7 C. pubescens plants, Fort Lupton, Weld Co. Colo., Sept. 8, 1987. Oviposition 10:55 6 eggs on 6 inflorescences, 1 egg & 1 2nd-stage larva found, all on Cardaria ("Lepidium") latifolia, Apex Gulch, Jefferson Co. Colo., June 30, 1991. Oviposition 12:06 on Lepidium densiflorum (W), Ute Lake, Quay Co. New Mex., May 14, 1985. Oviposition 10:03 Lepidium campestre tiny 5-mm leaf beside flower buds, Guy Hill, Jefferson Co. Colo., June 18, 1992. Oviposition 13:15 on Berteroa incana (W) flower bud, NE Valmont, Boulder Co. Colo., July 5, 1985. Mature larva found on B. incana inflorescence; Chatfield Res., Jefferson Co. Colo., July 30, 1990. Oviposition 11:30 on Rorippa sinuata flower bud, Barr Lake, Adams Co. Colo., Aug. 17, 1985. Oviposition 13:32 on top of leaf stem of Rorippa teres, Barr Lake, Adams Co. Colo., Sept. 28, 1987. ~10 half-grown to larger larvae found resting on top of R. teres leaves & stems, many reared to adults (determined by wing pattern, venation, signum bursa length); lab larvae prefer R. teres to R. sinuata; Barr Lake along canal, Adams Co. Colo., Oct. 11, 1989. 3 ovipositions 10:15-10:16 on top of leaves of seedling Chorispora tenella, Barr Lake, Adams Co. Colo., Sept. 8, 1987. Oviposition 10:20 on top of Barbarea orthoceras leaf, Genesee Sewage Plant, Jefferson Co. Colo., July 29, 1987. Oviposition 9:40 B. orthoceras flower buds, Apex County Park, Jefferson Co. Colo., May 29, 1991. Oviposition 10:12 Cleome serrulata leaf, Box Elder Creek, Arapahoe Co. Colo., Aug. 8, 1973. Oviposition 11:00 on C. serrulata flower pedicel, Barr Lake, Adams Co. Colo., Aug. 17, 1985. Ovipositions 10:18, 10:24, 10:24, 3 eggs on underside of leaves, several eggs on flowers, all on C. serrulata, Barr Lake, Adams Co. Colo., Aug. 19, 1986. Adults associated with C. serrulata, Barr Lake, Adams Co. Colo., Aug. 23, 1989. Ovipositions 13:12 three eggs on leaf tops 10 cm above ground where plant leaned over, preovipositions 13:22, 13:25, and 14:09, mature larva (reared to adult female with signum bursa 0.75 mm long) found resting on top of stem near branch tip in full sun, 42 eggs found on leaves (mostly upperside of leaves) (2/3 of eggs were on lower leaves where they were somewhat shaded by upper leaves or by surrounding plants), all on C. serrulata; one female searched only near the ground and beneath tall plants, other females flew up to plant tops reluctantly; adults common around C. serrulata; Barr Lake, Adams Co. Colo., Sept. 5, 1989. Adults are common in all habitats during years of abundance, so many hosts are weeds. EARLY STAGES from Barr Lake: Pupae hibernate. EGG cream, turning red-orange after a day. 1ST-STAGE LARVA orangish-yellow, with brown plates below brown setae, proleg plates & legs brown; head black. MATURE LARVA bluish-gray with many large black seta bases, a middorsal line on front half of body, a subdorsal and a lateral yellow band (each band consisting of, on each segment, yellow between segments, then white, yellow, white, yellow between segments), underside light olive-green with a yellow dash on side of each proleg base (and perhaps subventrally on A2 & A7); head light olive-green with a dorsolateral yellow spot, with many black seta bases, adfrontal sulcus brown, anterior eyes in a black crescent, lower part of frontoclypeus dark-brown. PUPA light-bluish-gray, grayish-cream, or greenish-cream, with many tiny black dots (on wing the dots are along between wing veins and near margin), a larger black dot above lateral ridge on front of each A5-8 segment, larger black lateroventral dots on A4-8, usually midventral black spots on A5-6 (usually an anterior spot with two legs in front and a posterior spot); the single head horn is tipped with ochre-brown; a tiny yellow anteriorly-directed bump just dorsal to antenna base; middorsal narrow line is orange-brown on thorax (brown tipped on T2 crest) and yellowish-cream on abdomen (except interrupted by ground color on A2, and black on front of each A4-8 segment); a subdorsal faint cream band is on thorax (very weak) & on abdomen of the darker

20 pupae; a lateral cream bump on T1 falls in line with a pale black-tipped orangish-cream bump on T2 wing base and in line with cream-gray inner margin of wing; a lateral ridge (lateral on A5-8 but running above wing on A2-4, where it protrudes esp. on A3) is orange-brown on A2-4 (darker red-brown on longest points, black on front on A4 and sometimes on front of A3) but on A5-8 is orange-brown on middle of segment and cream between segments; cremaster somewhat bifurcate with crochets in center dorsally but most crochets are ventral.

Pieris spp. (rapae, protodice, or callidice occidentalis). 11 eggs found on top of Rorippa teres leaves, 1 egg found on top of Rorippa sinuata leaves, Barr Lake along canal, Adams Co. Colo., Oct. 11, 1989. 1 egg (probably protodice) found on Cleome serrulata leaf top; Barr Lake, Adams Co. Colo., Sept. 8, 1990.

Pontia callidice occidentalis (Reak.). Adults associated with Descurainia richardsonii, NE Mineral Point, ~12,500', San Juan Co. Colo., July 18, 1988. Oviposition 11:44 on 1-cm-tall Cleome serrulata seedling under a 1-m-tall mature C. serrulata plant (ovipositing female identified by wing pattern and signum bursa 1.0 mm long); adults common around C. serrulata and males patrol for females there, C. serrulata was the only green Crucifer present although a few weeks later the water was stopped in a canal and Rorippa spp. became exposed and abundant; 3 eggs found on nearby C. serrulata seedlings may have been P. c. occidentalis or P. protodice; Barr Lake, Adams Co. Colo., Aug. 23, 1989. ~20 half-grown to larger larvae found resting on top of Rorippa teres leaves & stems, many reared to adults (determined by wing pattern, venation, signum bursa length); lab larvae prefer R. teres to Rorippa sinuata; Barr Lake along canal, Adams Co. Colo., Oct. 11, 1989. P. c. occidentalis flies sympatrically and synchronically with P. protodice at Barr Lake: they occur at the same patches of C. serrulata at the periphery of meadows, and near R. teres in the same canals; in 1989 the occidentalis peaks preceded those of protodice by about 2 weeks (occidentalis was common Aug. 23, scarce Sept. 5, less common Sept. 25, scarce Oct. 11, 21, whereas protodice was common Aug 23, very common Sept. 5, common Sept. 25, extremely common Oct. 11, and scarce Oct. 21 [a freeze occurred Oct. 15-16 which seemed to affect protodice more than occidentalis]); even though their hostplants, microhabitats, and mate-locating behavior (males of both species patrol about the Cleome to seek females) are the same, differences in timing of their flight peaks, larval color, wing pattern, wing venation, and length of signum bursa all prove that there is little or no hybridization between them. EARLY STAGES from Barr Lake: Pupae hibernate. EGG yellow-cream, turning orange-red after a day. MATURE LARVA dark bluish-gray with many large black seta bases, a middorsal line on front half of body, a subdorsal band (consisting of, on each segment, yellow between segments, then blue-white, yellow, blue-white, yellow between segments), a lateral band consisting of same colors, a subventral band of yellow spots on A2-7 (on side of proleg base on A3-6), the dorsolateral wide dark bluish-gray area is lighter in middle of segments; head bluish-gray except for dorsolateral yellow spot, with many black seta bases, adfrontal sulcus black, anterior eyes in a black crescent, lower part of frontoclypeus black. Older larvae differ from P. protodice by having darker (dark-bluish-gray) stripes (most larvae can be correctly identified but some cannot be): many pale larvae produced P. protodice, 2 somewhat-dark larvae produced 1 protodice 1 occidentalis, 2 larvae described as dark but becoming somewhat dark produced occidentalis, many dark larvae produced occidentalis. PUPA usually light bluish-gray, sometimes bluish-tan or bluish-cream (pupae average slightly darker than P. protodice) with many tiny black dots (on wing the dots are between wing veins and near margin), a larger black dot above lateral ridge on front of each A5-8 segment, larger black lateroventral dots on A4-8, midventral black spots on A5-6 (usually an anterior spot with two legs in front and a posterior spot); the single tanhead horn is tipped with orange-brown; a tiny yellow anteriorly-directed bump just dorsal to antenna base; a middorsal line is orange-brown on thoracic crest (the highest point--on T2 crest--brown) but cream on abdomen (except interrupted by ground color on A2, and black on front of each A4-8 segment); a subdorsal faint cream band is on thorax (very weak) & on abdomen of all except the palest pupae; a slight orangish-tan lateral ridge on T1 falls in line with a black-tipped orangish-tan bump on T2 wing base and in line with cream-gray inner margin of wing; a lateral ridge (lateral on A5-8 but running above wing on A2-4, where it protrudes esp. on A3) is orange-brown on A2-4 (darker red-brown on longest points, black on front on A4) but on A5-8 is orange-brown on middle of segment and cream between segments and sometimes black on front of A7 & A8; anal margin of wing base blackish-gray (wings turning yellowish before emergence); cremaster somewhat bifurcate with crochets in center dorsally but most crochets are ventral.

Pontia sisymbrii (Bdv.) (= elivata [B. & B], a very weak ssp.). Oviposition

Arabis (Boechea) perennans, NE Saguaro Lake turnoff, Maricopa Co. Ariz., March 20, 1969. Oviposition Arabis (Turritis) glabra, Lookout Mtn., Jefferson Co. Colo., May 22, 1980. 2 larvae (4th and 5th stages) found on pods of two A. glabra plants, both larvae silked the pods together and rested on a silk mat, Green Mtn., Jefferson Co. Colo., June 9, 1986. 4 eggs (probably P. sisymbrii) found on lower A. glabra leaves, Indian Gulch, Jefferson Co. Colo., April 30, 1988. Oviposition 10:12 on underside of leaf 1/3 from base to top of plant, 2 other eggs found halfway up this plant, 5 eggs found on three other plants about 1/3 from base to top, all on underside of A. glabra leaves; ovipositing females ignored Barbarea orthoceras along the creek and ignored Thlaspi arvense on hillsides; Apex Gulch, Jefferson Co. Colo., May 6, 1988. Oviposition 13:01 on side of stem 1/4 from base to top, oviposition 13:07 on underside of leaf 1/4 from base to top of plant, oviposition 13:12 on side of stem 1/4 from base to top, all on A. glabra, 4 other eggs found on two other A. glabra plants on side of stems and on underside of leaves about 1/4 from base to top of plants, all on N-facing slope among Cercocarpus montanus, the female ignored Erysimum asperum and numerous Thlaspi arvense; Green Mtn., Jefferson Co. Colo., May 9, 1988. 3 eggs (probably P. sisymbrii) found on stem, 1 egg found on leaf underside, all halfway up stem of A. glabra, Lookout Mtn., Jefferson Co. Colo., May 30, 1988. 4 orange eggs (probably P. sisymbrii) (2 under lower leaves, 2 on lower stem) found on A. glabra, Red Rocks, Jefferson Co. Colo., May 3, 1989. Oviposition 11:21 one egg on leaf underside 5 cm below top of 20-cm-tall plant, one egg found on underside of leaf base 12 cm below top of same plant, both on A. glabra, Tinytown, Jefferson Co. Colo., May 18, 1989. 2 eggs (probably P. sisymbrii) on underside of leaves halfway up A. glabra plants, Tinytown, Jefferson Co. Colo., June 2, 1989. 1 egg (probably P. sisymbrii) found on leaf underside halfway up A. glabra plant, Tinytown, Jefferson Co. Colo., June 6, 1989. 3 eggs (probably P. sisymbrii) on stem of Arabis (Boechea) drummondii 2/3 way up plant, Tinytown, Jefferson Co. Colo., June 8, 1989. Two eggshells (probably P. sisymbrii) found on A. drummondii stem halfway from base to top, Phillipsburg, Jefferson Co. Colo., June 17, 1989. Oviposition 14:30 on underside of leaf 60% up from plant base near stem of Arabis (Boechea) fendleri, eggs yellow-green when laid, Van Bibber Creek, Jefferson Co. Colo., May 26, 1988. Preoviposition, and egg, first-stage larva, and 3rd-stage larvae found on Descurainia richardsonii (W), Irish Can., Moffat Co. Colo., May 28, 1978. Oviposition Erysimum sp., Del Puerto Can., Stanislaus Co. Calif., Mar. 21, 1970 (this plant is probably refused by larvae). The favorite Calif. host (Streptanthus) does not grow on the Colo. E slope, where Arabis may be preferred. Egg yellowish-green when laid, becoming yellowish then orange after a day. FIRST-STAGE LARVA pale, with large red-brown plates at base of setae; head red-brown. MATURE LARVA white, with black pattern and yellow spots as follows, on top of body the black pattern consists of a rectangular patch extending from almost the middle of each segment to almost the middle of the next, the jagged sides of the rectangle extending laterally nearly to spiracles; within each rectangle are 1 transverse white, 1 transverse yellow, then 1 transverse yellow lines, then a yellow staple-shaped mark pointed rearward, except T1-2 rectangle has just 1 white line 1 yellow line, T2-3 has just 2 yellow lines, T3-A1 and A7-8 have 1 white line 1 yellow line 1 yellow staple, A8-9 has the ends of 1 white line missing its middle & 1 yellow staple; top and underside of A10 black; lateral white area has a yellow fat H-shaped spot centered on each intersegmental area; a fragmented sinuous sublateral black band has tongues of black running down the front of each leg and down the rear of each proleg; underside of body mostly white; head black with tiny short white processes and white streaks, middle of frontoclypeus white, white all around frontoclypeus, white in front of eyes to frontoclypeus, white behind eyes, and white around eye #6.

Neophasia menapia melanica Scott. Oviposition 5 m up Pseudotsuga menziesii tree, 12 mi. W Willits, Mendocino Co. Calif., July 13, 1964.

Neophasia menapia menapia (F. & F.). Adults assoc. only with Pinus edulis, Bear Creek, Fremont Co. Colo., July 26, 1965, Aug. 6, 1965, Aug. 8, 1969. Oviposition 13:10, the female fluttered and landed 3 times, then landed 4 m up on N side of an 8-m-tall Pinus ponderosa var. scopulorum tree and turned upside down and laid 10 eggs single file along top of needle, the eggs angled toward the leaf tip about 30° and cemented together with very copious glue that totally filled the spaces between eggs, the process took ~30 sec. and between laying each egg she lifted her abdomen and returned it to between her wings; Shingle Creek, Jefferson Co. Colo., July 27, 1988. Eggs hibernate.

Danaus plexippus plexippus (L.). 4 larvae on underside of Asclepias speciosa leaf, Morrison, Jefferson Co. Colo., July 13, 1985. Mature larva found on A. speciosa leaf top, Barr Lake, Adams Co. Colo., Sept. 25, 1989. 2 eggs found under A. speciosa leaves, Wheatridge, Jefferson Co. Colo., July 31, 1991. Older larva found on A. speciosa leaf top, Barr Lake, Adams Co. Colo., Aug. 30, 1991. Oviposition Asclepias incarnata, Wheatridge, Jefferson Co. Colo., July 27, 1973. Mature larva found on A. incarnata upper stem, nearby leaf eaten, Wheatridge, Jefferson Co. Colo., July 24, 1989. Larva on leaf of A. incarnata, Vineland, Pueblo Co. Colo., Aug. 4, 1983. Oviposition 13:45 on underside of leaf of small A. incarnata without flowers, E of Renville County Park, Renville Co. Minn., July 13, 1986. Larvae on Asclepias subverticillata, Crystal Creek near Black Canyon, Montrose Co. Colo., July 30, 1972. Adults assoc. with A. subverticillata (W), 6 mi. S Pagosa Springs, Archuleta Co. Colo., Aug. 28, 1977. EGG cream. 1ST-STAGE LARVA dirty cream, with gray-brown transverse stripes across dorsal part of body from T1-A8 (the anteriormost stripe is widest and consists of the T1-T2 stripes fused together), subdorsal cones on T2 and A8 correspond to later filaments, a dark-brown triangular suranal plate; proleg plates and legs brown; head black.

Satyrinae

Unfortunately, finding hosts of Satyrinae is difficult. Females oviposit at least somewhat haphazardly: some species often drop eggs from the abdomen tip, or oviposit on dead grass blades near or among the host, or oviposit on top of shrubs, or oviposit on rocks near the host, etc. The method of finding hosts is limited to observing ovipositions and finding eggs, because larvae cannot be found in nature at least in daytime (they are camouflaged, and may hide at the plant base by day). And many or most Satyrinae may be rather polyphagous on grasses/sedges in nature, because lab larvae can eat many grasses and sedges. Association of adults with potential hosts is useful. Despite all these problems, definite or probable hosts are known for most local Satyrinae.

Lethe eurydice fumosa Leussler. Females were watched (at Fort Collins park, Larimer Co. Colo.), and all monocotyledons near the eggs laid were identified and their abundance noted: oviposition 10:45 three eggs in a row on underside of leaf of Agrostis gigantea (W) (this was the commonest plant near egg, but Poa palustris [W] was also fairly common, one Festuca pratensis [W] plant was within 1-2 m, and a few plants of Carex lanuginosa [W] and Scirpus pallidus [W] were within 1/3 m); oviposition 10:55 3 eggs in cluster on underside of Polygonum sp. leaf (Agrostis gigantea [W] was commonest near eggs, Carex praegracilis [W] was uncommon nearby, and Carex lanuginosa [W] was rare nearby); oviposition 11:03 1 egg on underside of Agrostis gigantea (W) leaf (A. gigantea was the commonest plant near eggs, and Carex praegracilis [W] and the grass Agropyron [Elytrigia] repens [W] were uncommon near eggs); oviposition 11:20 3 eggs in row on underside of Agrostis gigantea (W) leaf (A. gigantea was the commonest plant near eggs, and Bromus [Bromopsis] inermis [W] was uncommon 30 cm from eggs); oviposition 12:02 2 eggs on underside of Agrostis gigantea (W) leaf (A. gigantea was common near eggs, but Poa palustris [W] was about equally common, and Carex lanuginosa [W] was uncommon near eggs); oviposition 12:10 one egg on underside of Agrostis gigantea (W) leaf (A. gigantea was common near egg, Poa aquassizensis [W] was less common in the understory near egg); oviposition 12:33 3 eggs within 4 mm of each other on underside of Lycopus americanus (Labiateae) leaf (Agrostis gigantea [W]) was the commonest monocotyledon near eggs, but Eleocharis palustris [W] was common in understory near eggs, a Carex nebraskensis [W] plant grew every 15-20 cm, and one clump of Juncus dudleyi [W] was 30 cm away from eggs), all Fort Collins park, Larimer Co. Colo., July 8, 1985. Oviposition 11:40 2 eggs on underside of Agrostis gigantea leaf (A. gigantea common 0-1 m, Poa pratensis even commoner 0-1 m, Dactylis glomerata large clump 70-90, Carex vesicaria 60, 70), 2 eggs found on underside of Dactylis glomerata leaves of very large clump (Agrostis gigantea scattered 10 cm onward), oviposition 12:00 2 eggs on underside of Poa pratensis leaf (P. pratensis thick nearby, Agrostis gigantea common 5 cm onward, Festuca pratensis 80-1 m, Carex vesicaria 30, 50), oviposition 12:25 3 eggs in cluster on underside of Agrostis gigantea leaf (A. gigantea widely scattered & a big clump 25 cm, Carex vesicaria common nearby [a

slough of this sedge], Poa pratensis 80-100), oviposition 12:37 1 egg on underside of Agrostis gigantea leaf (A. gigantea common 30-40, 30, 50, 60, 80, 1 m, Carex vesicaria 2, 5, 15, 20, 20, 20, etc. thick [a slough of this sedge], Carex nebraskensis equally common 15, 15, 18, 20, etc.), oviposition 13:18 1 egg on underside of Agrostis gigantea leaf (A. gigantea very common nearby, Poa pratensis even more common [by 50%] nearby), 1 egg found on underside of Agrostis gigantea leaf (A. gigantea very common nearby, Poa pratensis even more common [by 50%] nearby, Dactylis glomerata 45 large clump, 90, 90, 1 m), these eggs were reared to pupae (5 pupae reared), Fort Collins park, Larimer Co. Colo., July 12, 1988. At Fort Collins park and school, adults occurred in semi-shaded grassy/sedgy areas among cottonwood/willow and other trees at filled-in meanders next to streams. Paul Opler (pers. comm.) observed oviposition beneath a Thalictrum leaf also in Fort Collins. At Fort Collins school, Larimer Co. Colo., July 2, 1985, grasses were also common, and sedges found were Carex sp. probably emoryi (W). At Fort Collins meadow, Larimer Co. Colo., July 2, 1985, adults occurred next to sedges (Carex aquatilis) and tall grasses along sloughs through the grassy meadow. Oviposition 11:50 one egg on underside of Carex emoryi leaf 6 mm wide (C. emoryi few, Carex lanuginosa common nearby but has 2-3-mm-wide leaves); near Denver, Jefferson Co. Colo., July 14, 1990; Fort Collins females were released July 12, 1988, near Denver, where a small population flew 1989-90-91; plants in the open marsh where the colony was successfully established are Carex nebraskensis common in half the area, Carex lanuginosa common in much of the marsh, Carex stipata fairly common over rest of marsh, Carex simulata common over marsh, Carex praegracilis common in peripheral areas, Carex emoryi a few in satellite marsh where C. lanuginosa dominates, Scirpus pallidus a few at edge of marsh, Juncus arcticus ater sparse, Juncus alpino-articulatus sparse, Agrostis gigantea scattered but spotty all over marsh, Calamagrostis canadensis a few small spots at edge of marsh, Glyceria grandis all along tiny creek. OVIPOSITION AND HOSTPLANTS. When ovipositing, the female flutters slowly (with few wingbeats/sec., but hovering somewhat) before landing (other butterfly species hover more obviously before landing quickly) and bends the abdomen down and forward under a leaf; an average of 2.0 eggs are laid on each plant chosen. Colo. females are seen ovipositing far more frequently than other butterflies; but they have no more eggs to lay than females in other states and species; reconciling these two facts, I conclude that when not ovipositing, females must spend nearly all of their time resting in sedges/grasses, bushes and trees, and only fly in the moist grass sloughs when they want to oviposit (possibly but doubtfully, females live shorter lives and oviposit at a faster rate than other butterflies). Because adults are associated with and usually oviposit on Agrostis gigantea and it is the most common monocotyledon near the eggs, one could conclude that it is the most common host in Colo. This was confirmed by finding that lab larvae ate A. gigantea, Dactylis glomerata, and Poa pratensis well; they were fed to pupation mostly on the latter. Because females oviposit on these grasses in nature (and less often on sedges) and larvae eat them well, these three grasses--not sedges--are the main hostplants at the native sites in Colorado: Agrostis gigantea is the main host (24 eggs), and Dactylis glomerata (2 eggs) and Poa pratensis (2 eggs) are occasional hosts. However, Carex lanuginosa is probably the main host at the introduced site, where Carex emoryi was oviposited on. Lab larvae ate a green-wide-flat-leaf sedge (C. lanuginosa) well, and ate some of a green-narrower-flat-leaf sedge (Carex praegracilis), but ate none of a glaucous-wide-flat-leaf sedge (Carex nebraskensis), and would not eat several sedges with thick cylindrical leaves (Scirpus americanus [= "Schoenoplectus pungens"], Eleocharis palustris). Thus larvae no doubt also eat green-flat-leaf sedges in nature when they encounter them (this lab test was only a few days long, so perhaps larvae can eat Carex nebraskensis leaves somewhat, though perhaps its glaucous leaves repel larvae). Thus the Colorado populations are distinct in eating mostly grass, whereas populations farther east eat only sedges (except for a population near Ithaca, N.Y. that Arthur Shapiro found eats grasses). I once thought that Colo. populations are also genetically distinct in flying mostly in shade (populations farther east occur in open areas), but this preference for shade proved not to be genetic. Adults at the introduction site flew only in the open marsh and not in the surrounding woods (although in 1990 several females were seen in a small open marshy area in the woods); this seems to indicate that Fort Collins adults are NOT genetically adapted to woods, even though they now occur mostly in wooded places; further proof of this is the population crash suffered

24 by the Fort Collins park population in 1990, 1 year after someone dumped ~12 dump truck loads of fill dirt on half of the open area of the site (burying a spot where adults were formerly common and ovipositions were seen); the former native Colo. open marsh populations were evidently largely wiped out by water diversion, overgrazing (the Fort Collins meadow population has apparently been decimated by heavy sheep grazing), etc., leaving only the few current populations in marshy riparian woodland. EARLY STAGES from Fort Collins (and egg and 1st-stage also from Minn.): No diapause in lab; half-grown larvae must hibernate in nature. EGG pale cream, shiny, spherical. The eggs are fragile, and if the plant is picked the leaf dries and the eggs become distorted and die. Such mortality is unique among butterflies in my experience (eggs of other butterflies generally are strong enough to survive this); for lab rearing, eggs must be removed from their plant substrate by applying a drop of water until the adhesive is softened enough for removal. FIRST-STAGE LARVA green with 5 white lines (the subdorsal second and sublateral 5th lines wider than the others); head chitin-brown with a black points on each bumplike horn rudiment; Minn. larva cream (before feeding) with head orange-brown. 2ND-3RD-STAGE LARVA, body same as 1st stage; head green, mouthpart area brown, a red-brown anterior line extends from near eyes to long horn tip, on rear of horn this line is red-brown on tip then cream as it extends down to just below level of saddle between horns. MATURE LARVA green, a middorsal (paler-centered) dark-green band edged by narrow light-yellow line, then a light-green (paler-centered) broad band, a subdorsal yellow line, a green band, a narrow yellow line, a green band, a narrow yellow line, an olive-green band containing brown spiracles, a sublateral yellow line, (T1 has only the subdorsal and sublateral yellow lines, although the dorsal light-yellow line is weak on the rear half of T1), underside and prolegs dark-green, neck light yellow beside head near head stripe; head green, mouthparts brown surrounded by dirty-cream, the stripe on front of horn yellow at tip, orange-red just below, dark-green-black for most of the stripe down to the two black eyes (another larva has stripe orange-red [edged laterally by yellow] on tip, brown-black just below, then darker-green for most of stripe down to eyes), on rear of horn the stripe light-greenish-cream, white seta bases common on side of head lateral to head stripe. The older larval head stripe extends down to eyes, and the bumps lateral to this line are small, both traits similar to L. eurydice eurydice (Johan.) rather than to Lethe appalachia R. Cherm. Older larvae make a resting pad on the rearing jar, a silk mat equal to their length and width (these larvae also often rest on other larvae and lay silk over them, which causes difficulties in molting and pupation as the silk prevents the exoskeleton or head capsule from properly shedding, so to prevent deaths and deformities older larvae should be reared in isolation). PUPA bright-yellowish-green (front edge of T1 spiracle whiter-green in one pupa but not in another), wing veins and edge of mouthparts darker-green, greenish-yellow on underside of A5-8, a pearly-white line (widened upward in middle) connects two head horns, a pearly-white line runs along forewing edge from base to tornus, a large middorsal pointed hump (laterally edged with whitish-green at tip) on T2, a middorsal green band on T3-A9, a weak-yellowish-white subdorsal line on A2-10 or A3-10 (extremely weak on A1 or A2), a faint yellow sublateral line on A4-8 or A5-9. Oviposition to pupation 52-70 days in lab. ADULT BEHAVIOR. Males may fly slightly more readily in Colo. than in Minn. and Neb., although in all areas fumosa is very local, and adults spend at least 80% of their time resting and seldom fly more than 3-6 m before landing (behavior characteristic of very local butterflies such as Boloria improba acrocnema and Erebia theano). Adults often fly through brush and through tree branches, and frequently land 20 cm or so into the plant canopy, often in the shade. Six adults were found resting on the low leaves of an elm tree at midday. To locate females, males seem to occasionally patrol weakly all day, about 20 cm above ground (or just above the plant canopy), and soon rest again, though several patrolling males were followed up to ~30 m; patrolling males chase other males and Cercyonis pegala. But perching behavior was seen occasionally: one perching male rested 2 m above ground on an Alnus bush and chased a C. pegala and a Pieris rapae that passed near, and 2 other males rested on tall sedges and chased a passing male and a C. pegala. In my experience with fumosus (in Colo., Minn., Neb., S.D.) males patrol much more often than perch to locate females. In courtship of mated rejecting females, the female lands and closes her wings (and often swings down to hang from a leaf if the male persists), the hovering male often flaps his wings with wide amplitude beside and below her perch, then

when he lands he flutters his wings with lesser amplitude (perhaps 10-60 degrees above horizontal, 3-7 times/sec.) while butting her with his head, and he then curves his abdomen to attempt to join. Mating pairs were found at 10:15, 12:10, 14:26. Adults bask dorsally, and in warm temperatures turn parallel to the sun to avoid overheating. Adults were observed feeding on mud and on dung, but not on flowers. ADULT VARIATION. Ssp. fumosa adults in SW Minn., Neb., and Colo. show the same continuous individual variation in color, the palest adults forming 5-10% of the population in all three states: males are usually dark brown, the extremes light brown, whereas females are usually brown, the extremes tan (in L. e. eurydice, adults are less variable and average paler). Fw length averages longer in Colo.: it is 25.8 mm male & 27.9 mm female in Colo., 24.9 mm male & 26.7 mm female in SW Neb., 24.6 mm male & 26.4 mm female in Minn. (sample sizes are not given because of criticism from persons who decry any sampling of lepidoptera). HOSTPLANTS E OF COLO. Egg found under green leaf of Senecio among Carex aquatilis (C. aquatilis 0-400, Poa pratensis 60, 80 cm, Carex stipata 100, 100 cm), NE Alden, Freeborn Co., Minn., June 23, 1991. Assoc. with C. aquatilis, NE Alden, Freeborn Co. Minn., 1985-1991. Minn., Neb., and S.D. fumosa are assoc. with sedges in open areas, typically the sedge zone above the cattails and below the grassy edge of nearly-filled-in old lakes, sometimes in roadside ditches with sedges. L. eurydice larvae in states E of Colo. are known to eat only sedges (Steven Spomer, pers. comm., has reared Neb. and Iowa L. e. fumosa larvae in the lab on "nutsedge") and larvae do poorly on grasses (although a dry field population near Ithaca N.Y. eats both grasses and sedges in lab).

Cyllopsis pertepida dorothea (Nab.). Larvae (from eggs laid by lab females from Tinytown, Jefferson Co. Colo., July 30, 1978) ate Poa pratensis in lab; half-grown larvae hibernated. Scott (1986b) described & drew larva & pupa from Jefferson Co. Colo.

Coenonympha tullia ochracea Edw. Oviposition 11:52 on underside of dead grass blade (Festuca saximontana 3, 15, 25-30, 40, 40, 50, 50, 60 cm, Agropyron [Pascopyrum] smithii common 3 cm onward, Stipa comata 2 cm and probably elsewhere, Bouteloua [Chondrosium] gracilis 5, clump 10-40, clump 40-45 cm, Koeleria macrantha 9-120 cm, Oryzopsis exiguua 30-45, 50-80, 90-100, Danthonia parryi 70, 1 m), Guy Hill, Jefferson Co. Colo., June 17, 1988. Oviposition 10:22 (she did not hover but merely flew slowly) on underside of dead grass blade (Stipa comata 2, 12, common 20 cm onward, Bouteloua gracilis 5, 10, 15, 30, Agropyron [Pascopyrum] smithii 4, 12, 15, common 20 cm onward, Carex probably pennsylvanica heliophila 3, 6, 6, 10, 25, 20-30 cm onward, old Bromus [Anisantha] tectorum 3, 8, 20, 35, 60-100, Danthonia parryi 50, 60-70, 90-100, Festuca saximontana 20, 80, Poa 90), Guy Hill, Jefferson Co. Colo., June 19, 1988. Female fluttered slowly then oviposited 10:57 on tiny Bouteloua gracilis leaf (B. gracilis common 1-50 cm, Agropyron (Pascopyrum) smithii 5, 40, 45, 1m, Carex probably pennsylvanica heliophila 10, 10, 15, 20-50, 25, 30, 70-100, Festuca saximontana 25, 40, 50, 80, 90, Stipa comata 10, 12, 15, 20, etc. very common, Agropyron [Elymus="Sitanion"] longifolius 25, 40, 50), Guy Hill, Jefferson Co. Colo., June 20, 1988. Egg (#72) found on Festuca arizonica clump, (no other F. arizonica clumps nearby, Koeleria macrantha 5, 15 common, Festuca saximontana 10, 20, 20, etc., Agropyron [Elymus="Sitanion"] longifolius 20 etc., Carex probably pennsylvanica heliophila 15, 30, etc., Danthonia parryi 50, 60, 80, Oryzopsis exiguua 12-30 etc.), Guy Hill, Jefferson Co. Colo., June 21, 1988. Oviposition (#94) 12:00, she fluttered slowly then landed and bent abdomen on live Poa pratensis then crawled upward and laid egg on underside of dead horizontal P. pratensis grass blade 5 cm above ground (P. pratensis thick 0-1 m, Bouteloua gracilis 3-1 m, Danthonia parryi 10-1 m, Stipa comata 30, 40, 50, 90, 90, 1 m, Agropyron (Elymus="Sitanion") longifolius 10, 60, 1 m, Oryzopsis exiguua 40-80), Guy Hill, Jefferson Co. Colo., June 27, 1988. Egg found on Festuca idahoensis (F. idahoensis common 0-100, Stipa comata 20, 30, 40, 40, etc. common, Stipa viridula 30, Agropyron [Pascopyrum] smithii 50), SW Hot Sulfur Springs, Grand Co. Colo., June 28, 1989. Oviposition 11:50 on short Carex pennsylvanica heliophila leaf among Ceanothus fendleri patch (C. p. heliophila common 0-100 cm, Poa agassizensis 5-100 common, Agropyron [Elymus, "Sitanion"] longifolius 1, 10, 20, 30-100 common, Stipa viridula 10, 25, 30, 30, 40, Andropogon scoparius 1 m, Koeleria macrantha 1.4 m [dead inflorescences 40, 60, 80]); the female did not hover she merely flew a short distance landed and crawled a few cm to oviposit; Crawford Gulch, Jefferson Co. Colo., June 10, 1992. Oviposition 12:04 underside of dead horizontal Poa agassizensis leaf (P.

agassizensis thick 0-15 m, Bromus [Bromopsis] lanatipes 35-80), female did not hover she merely flew slowly and landed and crawled a bit to oviposit, Tinytown, Jefferson Co. Colo., June 13, 1992. HOSTPLANTS must be a variety of grasses (and probably also sedges, which are known hosts in Europe): Poa pratensis, Poa agassizensis, Festuca arizonica, Festuca idahoensis, Bouteloua gracilis, and Carex pennsylvanica heliophila had one egg apiece, and two other eggs were near Bouteloua gracilis, Festuca saximontana, Stipa comata, and Carex probably pennsylvanica heliophila. EGG yellowish-cream when laid, soon developing hundreds of orange-brown dots many of which are connected into random streaks and lines. 1ST-STAGE LARVA cream-tan, becoming green due to feeding, a middorsal brown line, then a wide unlined area, a subdorsal brown line, 2 narrower brown lines above spiracles, lateral ridge prominent and becoming paler green, 2 long tails; head brown.

Cercyonis pegala nephele (Kirby) (= boopis [Behr] = olympus [Edw.]). Oviposition 10:30 on edge of dead blade of Festuca arundinacea (W), Wheatridge, Jefferson Co. Colo., Aug. 7, 1984. Oviposition 13:02, female landed on Rosa leaf beneath shrub, and dropped an egg from abdomen, which fell and stuck to pine needle in litter (grasses within 30 cm of egg were many Andropogon [Schizachyrium] scoparius [W] and a few Poa agassizensis [W]), Genesee Mtn., Jefferson Co. Colo., Aug. 8, 1984. Oviposition 12:36, egg was extruded and dropped from above and stuck to Carex praegracilis (W) leaf, Lakewood, Jefferson Co. Colo., Aug. 7, 1984. Oviposition or preoviposition (egg probably fell into litter where it could not be found) on Solidago leaf above Poa pratensis (W) under a Populus tremula tremuloides tree (P. pratensis common nearby), Critchell, Jefferson Co. Colo., Aug. 2, 1987. Oviposition 11:51, she landed on horizontal green Poa pratensis blade 30 cm above litter and bent abdomen forward under and beyond leaf and an egg popped out and fell forward in a parabola into litter, egg (which must have been covered with adhesive) found stuck to dead grass blade in litter (P. pratensis 0-1 m, Agropyron [Elytrigia] repens 3, 3, etc. common, Carex nebraskensis 80, 90, Carex praegracilis 40-1 m), Lakewood, Jefferson Co. Colo., July 6, 1988. Oviposition 12:50, she landed on horizontal green Poa pratensis blade and bent abdomen down and forward and an egg popped out and fell in a parabolic curve into litter (P. pratensis thick in understory, Bromus [Bromopsis] inermis 0-1 m); oviposition 14:20, she landed on horizontal Bromopsis inermis blade and an egg popped forward and down into the litter (B. inermis common 0-1 m, Festuca arundinacea all around egg); oviposition 14:34, she landed on Polygonum coccineum leaf and bent abdomen down and a bit forward and shot an egg downward in a parabola, egg stuck to Poa pratensis leaf 5 cm above litter (P. pratensis thick near egg, Carex probably nebraskensis 25, 50); preovipositions 12:48, 12:48, 13:56 on Festuca arundinacea; Wheatridge, Jefferson Co. Colo., July 13, 1988. Oviposition 14:23, she landed on Cirsium arvense leaf and bent abdomen down and forward and an egg popped out and fell in a parabola into litter (Poa pratensis very thick below egg and all around, Agropyron [Elytrigia] repens 1 plant 30 cm, Bromus [Bromopsis] inermis 15, 15, 15, 20-1 m, common), Wheatridge, Jefferson Co. Colo., Aug. 12, 1988. Egg found on dorsal surface of vertical Festuca arundinacea leaf, Wheatridge, Jefferson Co. Colo., July 11, 1988. Oviposition 11:24 below Pinus ponderosa canopy, she landed on Agropyron (Elymus, "Elytrigia") dasystachyum and I disturbed her, she flew 10 cm and landed on A. dasystachyum again and bent abdomen beneath and forward and an egg dropped into litter where it was found stuck to a stem of A. dasystachyum 2 mm above dirt (A. dasystachyum 0-100, Poa pratensis 0-100 in understory of A. dasystachyum, Bromus [Bromopsis] inermis 35, 45, 90, 100, Agropyron cristatum ssp. 80), E of Shingle Creek, Jefferson Co. Colo., Aug. 17, 1989. Preoviposition 13:15 Carex praegracilis (Poa pratensis 20, Eleocharis 30); N Greenwood, Douglas Co. Colo., July 23, 1990. Oviposition 10:40, she landed on Festuca arundinacea and bent abdomen, a cream egg was found stuck to dead litter below (F. arundinacea 0-100, Poa pratensis 0-100, Bromus [Bromopsis] inermis 2-100); Wheatridge, Jefferson Co. Colo., Aug. 11, 1990. Oviposition 11:26, she rested on Bromus (Bromopsis) inermis leaf and abdomen bent down and far forward and egg shot forward & down and stuck to B. inermis leaf 15 cm above ground (B. inermis 0-100, Festuca arundinacea 2-100, Poa pratensis 2-100); oviposition 12:25, she landed on Festuca arundinacea leaf, bent abdomen down & forward, egg popped out and down into litter but could not be found (F. arundinacea 0-100, Poa pratensis 8, Bromus [Bromopsis] inermis 100); Wheatridge, Jefferson Co. Colo., Aug. 13, 1990. Female bent abdomen on Bromus (Bromopsis) inermis above Poa pratensis sward but laid no egg; Wheatridge, Jefferson Co.

Colo., Aug. 16, 1990. Oviposition 13:40, she landed on Festuca arundinacea and crawled up blade and let egg drop while abdomen was aimed downward, egg stuck to dead near-vertical Poa pratensis leaf (F. arundinacea 0-100, P. pratensis 0-100, Bromus [Bromopsis] inermis 15, 30, 30, 30, etc. to 10 m); Wheatridge, Jefferson Co. Colo., Aug. 18, 1990. Oviposition 12:40, she fluttered slowly landed & bent abdomen down & forward and an egg shot out and dropped 1 cm and stuck to brown part of Festuca arundinacea leaf 10 cm from tip (F. arundinacea 0-100, Bromus [Bromopsis] inermis 0-100, Poa pratensis common in understory 0-100), Wheatridge, Jefferson Co. Colo., Aug. 22, 1991. Prepupa found hanging from leaf of Phleum pratense leaf in large Poa pratensis meadow (host unknown), pupated, Falcon County Park, Jefferson Co. Colo., June 27, 1992. HOSTPLANTS: C. pegala evidently feeds on many non-dry green grasses, and perhaps also sedges, but so far Poa pratensis (~5-6 eggs) with narrow succulent leaves and Festuca arundinacea (~4-5 eggs) with wide tough leaves seem to be favorites; occasional hosts are Bromus (Bromopsis) inermis (2 eggs), Agropyron (E.) dasystachyum (1 egg), Carex praeograssilis (1 egg), Andropogon (Schizachyrium) scoparius (or Poa agassizensis) (1 egg). Larvae are known to eat Poa pratensis in the lab; they are not yet known to eat Carex. Festuca arundinacea has very tough straplike leaves, so perhaps this grass is not favored by larvae. Females no doubt oviposit haphazardly on or near numerous grasses. When I first saw a C. pegala egg pop out and shoot into space, I found it hard to believe, but many further observations prove that this happens more than 50% of the time; the egg is attached directly to a substrate only if the abdomen happens to contact something when the female decides to oviposit (the female seems to make no great attempt to make contact), otherwise the egg is shot into space and falls into the litter. Females generally oviposit when they are 10-40 cm above ground resting on a plant, so in contrast to the weak eggs of Lethe eurydice, the eggs must be tough enough to withstand the fall. All eggs must be coated with wet adhesive when extruded, because they usually stick to the first object they contact on their fall, so that up to 1/3 of falling eggs stick to objects above the basal thatch litter. Because females merely flutter more slowly than the usual flight before ovipositing, and because females DO shoot eggs into space, females must be watched VERY closely to detect oviposition and see the egg fall. Diapause of adult female pegala has been reported, but is doubtful, and does not occur in Colo., where my latest records are Sept. 7 & 30 for males and Sept. 23 for females, though the sex ratio after Sept. 15 is about 25% males. Unfed first-stage larvae hibernate. EGG cream when laid, soon developing about 100 diffuse purplish-red spots. FIRST-STAGE LARVA tan, with a rosy dorsal flush on T3-A4, A10 yellowish, a middorsal dark-red line, two red (or brown) subdorsal lines, a weaker brown lateral line, white scythe-like setae; head yellow-tan with short brown setae. PREPUPA green, darker heart-line, a subdorsal yellowish line; head olive green, eyes 1-5 brown. PUPA light green (green with cream mottling, wings streaked with green and cream-green), a middorsal cream line (twinned on abd.), subdorsal cream line, the sharp upper edge of wing cream (this edged above by green and on wing base a blackish dot), a cream transverse line on sharp lower edge of head, abdomen has a faint cream lateral band and slightly-darker midventral band.

Cercyonis oetus charon (Edw.). Oviposition 11:39 on dead grass blade below canopy of Ceanothus fendleri prostrate shrub, the only grass there was Poa agassizensis (W), Genesee Mtn., Jefferson Co. Colo., Aug. 8, 1984. Oviposition 11:33 on underside of dead grass blade in litter among Eriogonum umbellatum (the only grass present was Poa agassizensis (W) common), oviposition 12:57 on underside of pine needle in litter near Solidago, Astragalus, and the grass Koeleria macrantha (W) (3 or more other grass species were within 1 m, and the oviposition was quick so the female doubtfully knew which grasses were near), both Corwina Park, Jefferson Co. Colo., Aug. 27, 1984. Oviposition 11:08 on small leaftip of Cercocarpus montanus (in partial shade of this 25 cm tall bush) (Poa agassizensis 3, 4, 8, 10, 15, 15, 20, etc., common in a sward, Stipa comata 10, 12, 15, 20, etc. common, Carex probably pennsylvanica heliophila 17, 20, 30, 30, etc., Bouteloua [Chondrosium] gracilis 50-1 m), Shingle Creek, Jefferson Co. Colo., July 27, 1988. Oviposition 12:11, she landed in little clearing 10 cm wide on ground, crawled 7 cm and laid an egg on underside of dead horizontal grass blade in litter (Poa near agassizensis abundant 5-100, Carex probably pennsylvanica heliophila 2, Agropyron [Elymus="Sitianion"] longifolius 20, Agropyron trachycaulum 30, Bromus [Bromopsis] lanatipes 85, 100, Stipa probably viridula 90), Tinytown, Jefferson Co. Colo., Aug. 21, 1989. Egg found

on Festuca idahoensis (F. idahoensis abundant 0-100, Agropyron [Elymus="Sitanion"] elymoides 30, 40, Stipa comata 5, 25, common 40 cm onward, Bromus [Bromopsis] inermis 60, 100), SW Hot Sulfur Springs, Grand Co. Colo., June 28, 1989. Pupa (~13 wasps later emerged from) found attached to Potentilla gracilis var. pulcherrima leaf underside, the leaf silked somewhat so that it is concave downward to form an umbrella about the pupal abdomen, Festuca idahoensis common nearby; SW Como, Park Co. Colo., July 17, 1990. HOSTPLANTS: Front Range females seem to prefer Poa agassizensis (4 eggs), and no doubt occasionally oviposit on many other grasses including Koeleria macrantha; in W Colo. Festuca idahoensis is a popular host. C. oetus occurs in drier habitats than C. pegala, and Poa agassizensis is the native drier-habitat (rich-soil hillsides and sloping swales) relative (perhaps a ssp.) of C. pegala's favorite host Poa pratensis (which occurs in moist swales). Females release the eggs while on the litter or while up to 10 cm above ground, closer to the ground than C. pegala. Female Cercyonis hop-flutter when they search for a place to oviposit, and the flight is only slightly more fluttering than the normal hopping flight, in contrast to non-Satyrinae (and skippers) in which the oviposition flight is much more fluttering. Unfed first-stage larvae hibernate. EGG cream when laid, developing 100-200 diffuse red or red-brown spots. PUPA light green, a middorsal cream band, a subdorsal cream band, the inner angle of wing is cream edged dorsally by dark green, a subspiracular cream abdomen band, intersegmental areas between A4-7 tan, cream beneath anterior transverse ridge of head, spiracles & crochets chitin brown.

Cercyonis meadi meadi (Edw.). Adults associated with Bouteloua (Chondrosium) gracilis and Andropogon (Schizachyrium) scoparius, South Platte River Canyon, Jefferson & Douglas Cos. Colo. Adults associated with B. gracilis & A. (S.) scoparius, etc., NE Foxton, Jefferson Co. Colo., Aug. 25, 1990. Adults associated with A. (S.) scoparius, Stove Mtn., 10,000', El Paso Co. Colo., Aug. 19, 1989.

Cercyonis meadi alamosa T. & J. Emmel. Adults associated with Bouteloua (Chondrosium) gracilis in San Luis Valley, Colo., which is probably a hostplant there. Adults associated with B. gracilis, Jaroso, Costilla Co. Colo., and W Cerro, Taos Co., New Mex., Aug. 15, 1989. Adults associated with Sporobolus airoides (almost the only grass present, except for a small patch of Distichlis spicata var. stricta), which must be a host, unless adults fly far to find the rabbitbrush flowers at this site; 5 mi. N Moffat, Saguache Co. Colo., Aug. 22, 1990.

Erebia magdalena magdalena Strk. Oviposition 12:28 on side of rock near Luzula spicata (Juncaceae, which larvae doubtfully eat)(W) on a slope above a rockslide, Loveland Pass, Summit Co. Colo., July 27, 1978 (Carex albonigra, Carex rupestris drummondiana, and Carex phaeocephala were also found at this spot). Vegetation around rockslide where adults were common was C. r. drummondiana common, Luzula spicata common, Carex haydeniana fairly common, Festuca brachyphylla coloradensis a few, Poa arctica a few; Loveland Pass, Summit Co. Colo., July 29, 1989. Females fly for short periods and usually land on rocks, and several possible ovipositions on rocks were seen before I learned to search the rocks for eggs after females departed. The newly hatched larvae evidently drop off of or crawl away from the rocks to find food, and are doubtfully restricted to a single host. Four young larvae ate Poa pratensis well (grew to half-grown on it), ate some Carex rupestris drummondiana leaf tips, and ate some Carex nebraskensis (but less of it than Poa pratensis). Michael Young found that larvae eat Poa pratensis in the lab, and larvae hibernate. My half-grown larvae died in lab. EGG cream when laid, turning slightly-reddish cream. FIRST-STAGE LARVA cream at hatching, after feeding light bluish-green on top half of body from T1-A4, from A5-A9 the blue-green color diminishes greatly posteriorly, the rear and underside tan, red-brown lines present (1 middorsal band, 2 dorsolateral lines, 1 band just above spiracles, a whitish lateral band has a faint narrow red-brown line edging it beneath), seta bases black; head black. 2ND-STAGE LARVA bluish-green on T1-A4, bluish-greenish-tan on A5-A10, 4 bands that are brown anteriorly, red-brown on rear (1 middorsal, 2 dorsolateral, 1 just above spiracles), numerous tan setae with brown bases; head black. HALF-GROWN LARVA yellow-green, with dark-brown bands (middorsal, 2 dorsolateral, 1 on top edge of spiracles), below spiracles a dark brown line edging an ochre band on lateral ridge, a dark-brown band just below lateral ridge, thousands of tan setae; head black.

Erebia theano ethela Edw.. Oviposition 8:55 on dead "grass" leaf within 10 cm of Carex foenea (W) and Poa nemoralis interior (W) and a few Poa fendleriana

var. longilicula and Festuca brachyphylla coloradensis; oviposition 11:29 on dead "grass" leaf within 10 cm of C. foenea (W) and F. b. coloradensis (W) and some P. n. interior and a few P. f. var. longilicula; oviposition 13:15 on dead twig within 10 cm of C. foenea (W), P. nemoralis (W), and Agropyron (Elymus) trachycaulum (W); oviposition 12:27 on dead "grass" leaf within 10 cm of Luzula parviflora (W) and C. foenea (W); C. foenea, P. nemoralis, & A. trachycaulum were the commonest monocotyledons at this site, F. b. coloradensis and P. f. var. longilicula were less common, and there were a few Trisetum spicatum spicatum; logging about 30 years previously had created its grassy habitat; all N-facing slope on Rollins Pass Road, 11000', Gilpin Co. Colo., Aug. 5, 1978. It is tempting to assume that Carex foenea is the usual hostplant at this site, but its edibility to larvae has not been tested (larvae do eat Poa pratensis in lab). Adults (ssp. demmia Warren, a weak ssp.) is associated with Calamagrostis canadensis (W) and another coarser grass, Weminuche Pass vicinity, Hinsdale Co. Colo., July 31, 1972. The preferred habitat is fairly long grass/sedge, which logging can provide; certainly the habitats should not be allowed to be destroyed by the overgrowth of trees, so logging (even clear-cutting) or fire should be practiced. E. theano is biennial in Colo., occurring mainly on even years as adults (except for one odd-year colony in the San Juan Mts.) and hibernating as a larva, a young larva during the first winter, perhaps an older larva during the second winter. Larvae eat Poa pratensis in the lab. FIRST-STAGE LARVA cream, lines very faint; head tan. SECOND-STAGE LARVA cream, with red-brown lines (1 middorsal narrow band, 1 narrow dorsolateral line just above a wide dorsolateral band, a weak brown line along spiracles edged below by a tan band on lateral ridge, this edged below by a brown line); head tan. HALF-GROWN LARVA (Corona Pass) ground color brown, a fold between each segment appears as a dark line, a wide middorsal blackish-brown band is edged by tan, next a broad brown band, a dorsolateral paler-blackish-brown band is above a pale-brown band, which is just above a blackish line that edges the top of a brown band mottled with blackish, a narrow tan band below that, then a wide brown band containing black spiracles has dark-brown streaks between spiracles, the lateral ridge is pale-brown and is sharply-edged below by blackish-brown, a sublateral mottled blackish-brown band, underside mottled brown with pale-brown prolegs & legs, two very short tails on rear, body covered with slightly-curved thick setae with dark-brown slightly-enlarged tips; head brown, with shorter slightly-curved brown setae with brown slightly-enlarged tips, no horns.

Erebia epipsodea Butl. 2 ovipositions on Poa pratensis saddle: the female bent abdomen on P. pratensis dead blade, flew then oviposited 14:40 on Oenothera coronopifolia (not a host) (P. pratensis 0-10 m, Stipa sp. 45, 55, 70, 100), landed on P. pratensis twice more, then oviposited 15:00 dead P. pratensis leaf (P. pratensis 0-10 m, Stipa sp. 1 m, Carex pennsylvanica heliophila 0-5 m); Tinytown, Jefferson Co. Colo., June 16, 1992. Adults associated with Poa pratensis/agassizensis, Crawford Gulch, Jefferson Co. Colo., June 10, 1992. Female bent abdomen 3X on Poa agassizensis, Tinytown, Jefferson Co. Colo., June 13, 1992. Oviposition 10:20 Carex pennsylvanica heliophila dead (for last 3 cm) leaf tip 3 mm from tip (C. p. heliophila 0-100, Poa pratensis 0-10 m, Stipa comata 20, 20, 50, 60, Agropyron (Elymus, "Sitanion") longifolius 12, 20, 30, 40, 50, 90, 100, etc., Koeleria macrantha 70, Danthonia parryi 60-70, 100); oviposition 12:05 Koeleria macrantha vertical green leaf tip (2 cm from tip) (K. macrantha 0-25, 50, 30-90, 100, etc. commonest grass near egg, Agropyron (Elymus, "Sitanion") longifolius 7, 30, 30, 40, 40, 50, 80, etc. common, Poa pratensis 5, 5, 7, 10-100, Bouteloua gracilis 70-100; oviposition 14:55 middle of 20-cm clump of Danthonia parryi on slightly-leaning dead (on last 2 cm) leaf tip 1 cm from tip (D. parryi 0-10, 50, 60, 90-100, Poa pratensis 5, 7, 7, 7-100 thick, Bromopsis porteri 15, 30, 35, 70, 70, etc., Agropyron (Elymus, "Sitanion") longifolius 30, 50, Stipa comata 30, 40, 50, 80); oviposition 15:30 Poa pratensis dead (on last 1 cm) leaf tip 2 mm from tip (P. pratensis 0-10 m, Agropyron (Elymus, "Sitanion") longifolius 7, 25, 25, 30, 30, 40, 40, 60, etc., Bromus (Bromopsis) inermis 35, 50, 80); Guy Hill, Jefferson Co. Colo., June 18, 1992. Preoviposition 15:25 dead grass among Poa pratensis (Oryzopsis micrantha) and Bromus (Bromopsis) inermis 5 cm away etc.), Tinytown, Jefferson Co. Colo., June 17, 1992. Oviposition 10:24 vertical Poa pratensis dead leaf tip (last 5 cm dead, egg 1.5 cm from tip) (P. pratensis 0-10 m, Agropyron (Elymus, "Sitanion") longifolius 7, 15, 20, 30, 30-100 common, Stipa comata 25, Koeleria macrantha 30, 30, 40-60); oviposition 14:54 vertical Carex pennsylvanica heliophila dead leaf tip (last 2.5 cm dead, egg 1.5 cm from tip) (C. p. heliophila 0-100, Poa pratensis 2-100, Danthonia parryi 8, 15, 40, 40, 50, 70,

80, Koeleria macrantha 25, 30, 40, 50, 50, 60, Stipa comata 7, Bouteloua gracilis 10), Guy Hill, Jefferson Co. Colo., June 22, 1992. HOSTPLANTS: Poa pratensis has 3 records, Carex pennsylvanica heliophila 1, Koeleria macrantha 1, Danthonia parryi 1; no doubt a variety of grasses and perhaps sedges are eaten, though by adult association P. pratensis is the most common host. Ovipositing females do not hover, they just fly slowly and land and crawl a few cm to oviposit, mostly on dead narrow leaf tips or dead leaves rather high in the turf (not in litter) (perhaps to place them out of reach of more ants) so the act of oviposition is generally rather acrobatic as she hangs onto one or two narrow blades to oviposit on an equally narrow blade, thus female epipsodea are the "monkeys" of the adult butterfly world, as Amblyscirtes are the monkeys of the larval world. Larvae were reared to pupae on Poa pratensis. EGG cream, soon developing a hundred purplish spots (each formed of many tiny dots). 2ND-STAGE LARVA from Colo. tan with white & brown stripes (a brown middorsal band is edged by a narrow white line, then a tan band, a brown line, a white band, a wide brown band, a white line, a brown line, a white lateral band, a brown line below it, tan beneath); head tan. No diapause in lab.

Erebia callias callias Edw. Oviposition 8:59 on dead grass blade in clump of Poa fendleriana var. longiligula, nearby was Carex rupestris drummondiana (W); oviposition 9:05 on dead grass blade among Poa fendleriana var. longiligula, nearby was Poa glauca (W); oviposition 9:58 on dead grass blade among Poa nemoralis interior, nearby was Agropyron (Elymus) scribneri (W); Festuca brachyphylla coloradensis also common at this site; Loveland Pass, Clear Creek Co. Colo., July 27, 1978. 1 egg (egg and 1st-stage larva resembles callias) found on Arenaria fendleri var. tweedyi leaf (Carex rupestris drummondiana 10, 8-15 cm away, Calamagrostis purpurascens? 10, Helictotrichon mortonianum clump 25, Poa fendleriana var. longiligula 20, 25), Hoosier Pass, 12000', Park Co. Colo., Aug. 31, 1988. 1 egg found on dead horizontal culm in Festuca brachyphylla coloradensis clump (F. b. coloradensis 0-3, abundant 5-100, Carex rupestris drummondiana 20-40, 30-100, Poa glauca 50, Helictotrichon mortonianum 20, 22, common 30-50, 90), Loveland Pass, Clear Creek Co., Colo., July 22, 1989. Egg found 13:16 on dead horizontal blade in Festuca brachyphylla coloradensis clump (F. b. coloradensis 0-30 common, Helictotrichon mortonianum 17, 25, 30, 30, 35-50, 40, 60, etc. abundant, Carex foenea 70, 75, Poa glauca 55, 70, Poa fendleriana var. longiligula 30, 60, Carex rupestris drummondiana 40); egg found 13:31 on dead horizontal grass blade in Festuca brachyphylla coloradensis clump (0-15, 10, 10-30, etc. common to 100, Helictotrichon mortonianum 18, 20, 20, 30, 30, 40, etc., Poa fendleriana var. longiligula 20-30, 35, 40, 40, 40, Carex rupestris drummondiana 0-15, 0-15, common 15-100); egg found 13:39 on dead horizontal blade in Festuca brachyphylla coloradensis clump (F. b. coloradensis common 5-100, Carex rupestris drummondiana 2, 2, 5, 8, 10, etc. common to 100, Helictotrichon mortonianum 15, 17-30, 25, etc. common, Poa glauca 15, 17, 25, 30, etc.); egg found 13:50 on dead horizontal grass blade next to Carex foenea (1, 15, 20, 25, 30, etc. to 100) and next to Helictotrichon mortonianum (3, 6, 10, 10, 20, 30) (Carex rupestris drummondiana common 5-100, Festuca brachyphylla coloradensis 2-5, 8-15, etc. common to 100, Poa glauca 40); egg found 14:24 on vertical dead blade in Kobresia myosuroides clump (K. myosuroides most of vegetation 0-10 m, Carex rupestris drummondiana 2, 5, 5, 7, 7, 10, 10, common to 100, Helictotrichon mortonianum 10, 15, 15, 20, 20, 40, 50, etc., Luzula spicata 40, 40); egg found 14:37 on vertical dead blade in Kobresia myosuroides clump (K. myosuroides most of vegetation 0-8 m, Carex rupestris drummondiana 2, 4, 8, 10, 14, 15, etc. common to 1 m, Helictotrichon mortonianum 15, 20, 70, 70, 90, 100, Festuca brachyphylla coloradensis 20, 35), Loveland Pass, Clear Creek and Summit Cos. Colo., Aug. 3, 1989. Females oviposit rather haphazardly among grasslike clumps, placing each egg on the underside of a dead blade. Adult association is therefore important for determining probable larval foods: the sedge Kobresia myosuroides (W) is the main and often the only plant where adults are common, at Loveland Pass, Summit Co. Colo. (many years data), at NE Gray's Peak, Clear Creek Co. Colo., Aug. 4, 1984, at Houghton Mtn., San Juan Co. Colo., July 22, 1980, at NE Rio Grande Pyramid, Hinsdale Co. Colo., July 31, 1972, and at Uncompahgre Peak, Hinsdale Co. Colo., Aug. 3, 1979. The two eggs found on Kobresia myosuroides, together with the fact that adults are most often found on K. myosuroides knolls, seem to prove that it is the most frequent hostplant in nature, and E. callias has adapted to it; K. myosuroides is the climax dominant of mature tundra soils, forming dense swards on top of thick-soiled gentle knolls and flats where E. callias is common, and where other monocots such as Poa fendleriana var. longiligula, Festuca brachyphylla coloradensis, Carex

rupestris drummondiana, and Poa glauca are scarce. A 1st-stage lab larva ate Poa pratensis, but ate no K. myosuroides (in nature larvae may eat K. myosuroides only in June-July when it is more tender, because larvae probably hibernate as young larva then older larva). Other hosts may be Festuca brachyphylla coloradensis (4 eggs), Poa fendleriana var. longiligula (2 eggs), Poa nemoralis interior (1), Carex rupestris drummondiana (1), Carex foenea (1). Larvae perhaps feed on many sedges and grasses. Probably biennial, but flying every year; my 3rd-stage larvae died in lab. EGG light-bluish-green, with ribs on side and bumps around top. FIRST-STAGE LARVA blue-green on thorax, tapering rearward to creamy-tan on rear, with red-brown bands (1 middorsal, 2 dorsolateral, 1 along spiracles), a light-brown band below lateral ridge, many tan spines with black bases; head black. 3RD-STAGE LARVA brown (a blue-green tinge on top of thorax), a blackish heart-band edged by a tan line, 2 dorsolateral blackish lines, a dark-brown line along spiracles, a brown band below light-brown lateral ridge, numerous tan setae with dark-brown bases; head black.

Neominois ridingsii (Edw.). Six ovipositions on Bouteloua (Chondrosium) gracilis, one oviposition on Koeleria macrantha (previously reported as Koeleria cristata, now a syn. of K. macrantha), one oviposition on Artemisia frigida (near B. gracilis), oviposition on dead twig while sitting on A. frigida (near B. gracilis); the main host here is undoubtedly Bouteloua gracilis which forms the main ground cover; 1 mi. up Bear Creek, Chaffee Co. Colo., June 1969, June 1970. Oviposition on Agropyron (Elymus="Sitanion") longifolius ("Sitanion hystrix"), Round Mtn., Custer Co. Colo., June 1970. Oviposition on Stipa comata; oviposition on top of Helianthus pumilus (6) bush; Bull Domingo Mine, Custer Co. Colo., June 1970. Oviposition on top of Gutierrezia sarothrae (6) shrub (probably near Bouteloua gracilis), Ben West Hill, Custer Co. Colo., June 1970. Females oviposit on either green or dead vegetation, either a shrub or herb or grass, wherever the female happens to be during warm parts of the day (ovipositions 9:16, 9:16, 9:33, 10:05, 10:08, 10:13, 10:21, 12:21, 12:31, 12:32). Females most often oviposit on grasses, but in hot weather females move to the top of shrubs to escape the heat, where they oviposit. The hesitant oviposition flight is not as noticeable as in other butterflies such as skippers. Scott (1973a) reports ecology, behavior, and movements. Adults are biennial in the Hudsonian Zone of Calif., but seem to be annual in Colo.

Geneis alberta alberta Elwes (= "oslari" Skin.). Live egg (#89) found on Festuca idahoensis large clump (F. idahoensis 25 cm, 30, 60, 1 m, Muhlenbergia torreyi 5-1 m, Koeleria macrantha 15-30, Carex oreocharis 40-1 m, 90, Agropyron (Elymus="Sitanion") longifolius 45), shriveled egg (#78) found on Festuca idahoensis large clump (F. idahoensis 0-30, 70-1 m, Muhlenbergia torreyi 5-1 m, Carex oreocharis 25-35, Agropyron (Elymus="Sitanion") longifolius 1 m, 1 m), eggshell (#82) found on Festuca idahoensis large clump (F. idahoensis 50, Muhlenbergia torreyi 0-1 m, Bouteloua [Chondrosium] gracilis 20-1 m, Agropyron (Elymus="Sitanion") longifolius 25, 40, Carex oreocharis 70, 50-1 m), eggshell (#85) found on Festuca idahoensis large clump (3 F. idahoensis clumps 1 m, Muhlenbergia torreyi 5-1 m, Koeleria macrantha 5, 25-40, etc. to 1 m, Carex oreocharis 5-1 m); all 4 eggs were ~4 cm above ground on downslope side of Festuca idahoensis clumps; SW Jefferson, Park Co. Colo., June 23, 1988. Adults associated with Festuca idahoensis; widespread NE end South Park, Park Co., Colo., June 2, 1990. Obviously Festuca idahoensis is the major host in this area because all the monocots were searched somewhat; it is associated with adults everywhere in Park Co. and is the largest bunch grass (Muhlenbergia torreyi grows in a matlike ring with dead center and is somewhat dry, and Agropyron [Elymus="Sitanion"] longifolius grows in shorter bunches but is shunned by butterflies). Adults associated with Festuca idahoensis, NW Tabernash, Grand Co. Colo. (adults found here early June 1989 by Andrew Warren, sited revisited June 24, 1989 by Warren and J. Scott). EGG white, the valleys turning reddish-white. FIRST-STAGE LARVA whitish-tan (slightly bluish-green on top of front half of body), middorsal brown heart-band, a narrow brown subdorsal line, a brown supraspiracular band, a brown band just below lateral ridge; head tan, with two faint brown bands corresponding to the medial two bands of older larva (one beside coronal sulcus, the other lateral to that band).

Geneis chryxus chryxus (D. & H.). Oviposition 10:12 the female flew slowly (not hovering) under/near trees a few times then landed on a 2-m-tall unsawed dead stump in partial shade of Ponderosa Pines and laid egg 1.5 m above ground just beneath hanging strip of wood (Carex rossii 30-80, 40-60, 60-80, 80, 80, 90, 1 m, Agropyron [Elymus, "Sitanion"] longifolius 100, Oryzopsis exiguua 40,

50, 80, 85, 90, 1 m, 1 m); 31 eggs found under Ponderosa Pine canopies (height of egg above ground, thickness of branch and whether it had bark or bark was gone, and distance of monocots from where egg would fall is noted): egg found 80 cm up on bark of 3 cm branch (*C. rossii* 30-90, 75, 100, 100, common, *Koeleria macrantha* 80, *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 40, 40, 45, 80, 80, 90, 90); egg found 8 cm up on 4-mm-thick twig (*C. rossii* 15, 35-100, 50, 50, 50, 60, 60, 70, common, *O. exiguus* 50, 90, 100, 100, *Stipa comata* 90); egg found 10 cm up on bark of 5 cm fallen branch (*C. rossii* 15-25, 40, 45-100, 50-100, *O. exiguus* 10-15, 15, 30, 50, *Stipa comata* 30, 40, 50); egg found 1 m up on bark of 3 cm twig (*C. rossii* 10, 10, 10-50, 40, 45, 60-80, 60-100, *Stipa comata* 60); egg found 8 cm up on bark of 3 cm fallen branch (*C. rossii* 15, 30-100, 35, 35-100, common, *O. exiguus* 15, 20, 30, 30, 40, 40 common); egg found 1.5 m up on bark of 3 cm fallen branch lodged against trunk (*C. rossii* 0-15, 40-100 common); egg found 5 cm up on 4 mm fallen twig (*C. rossii* 17, 25, 80, 90, *Stipa comata* 50, 60, 60, 100, 100, *O. exiguus* 90); egg found 5 cm up on 4 mm twig (*C. rossii* 5, 10, 10, 30, 30, 30, 30 thick to 100, *O. exiguus* 50); egg found same tree 1 m up on side of barkless branch 3 cm thick (*C. rossii* 15-100, 30-100, 30, *Stipa comata* 50, 80); egg found 30 cm up on 6 mm barkless twig of fallen branch (*C. rossii* 5-20, 30-60, 30-65, 40, etc. common, *O. exiguus* 60, 80, 80, 90); egg (with hole made by trichogrammatid) found 30 cm up on 6 mm twig (*C. rossii* 30-60, 50-70, 80-120, *O. exiguus* 30-50, 35, 50); egg found 25 cm up on bark of fallen 3 cm twig (*C. rossii* 20-45, 90, 90, 100, sparse); egg found 40 cm up on 10 mm twig (*C. rossii* 25, 50, 60, 80-100, 100); egg found 40 cm up on 2 cm barkless branch (*C. rossii* 7, 10, 10, 15, 15, etc. common to 100); egg found same tree, 8 cm up on 4 mm twig (*C. rossii* 30-60, 80-100, 70, 80, etc., *O. exiguus* 100); egg found 10 cm up on 1.5 cm barkless branch (*C. rossii* 5-100, 50-100, 60-100); egg found 8 cm up on bark of 6 mm fallen twig (*C. rossii* 10-35, 35-70, 40-100, *O. exiguus* 80-90); egg found 25 cm up on 4 mm fallen barkless branch (*C. rossii* 15-30, 30, 30-120, 50, 70, *O. exiguus* 30-50, 60, 60, 70); egg found same branch 25 cm up on 6 mm barkless twig (*C. rossii* 8, 10, 15, 15, 35, 50-100, *O. exiguus* 40, 50, 75); egg found same tree, 8 cm up on bark of 2 mm live twig (*C. rossii* 0-80, 60, 60, etc., *O. exiguus* 45, 50, 100); egg found 70 cm up on bark of 2 cm branch (*C. rossii* 5, 10, 25-70, 40, 60, 60, 60, *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 50, 60, *Koeleria macrantha* 90); egg (with hole made by trichogrammatid) found same tree, 60 cm up on bark of 5 mm twig (*C. rossii* 8, 30, 30-100, 40-60, 60, etc., *O. exiguus* 30-100, 100, *Koeleria macrantha* 90, *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 60); egg found 1.2 m up on bark of 1 cm branch (*C. rossii* 5-100 all around common, *O. exiguus* 50, 60); egg found 20 cm up on 1.5 cm fallen barkless branch (*C. rossii* 15-40, 50, 50-100); egg found 1.8 m up on bark of 10 cm branch (*C. rossii* 2-10, 20, 20-50, 30-100, 35-70 etc., *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 70, 100); egg found 50 cm up on bark of 1 cm twig (*C. rossii* 0-100, 20-35, 60-70); egg found 20 cm up on bark of 5 mm twig (*C. rossii* 7-40, 40-100, etc., *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 10, 10, 15); egg found 60 cm up on bark of 8 mm twig (*C. rossii* 0-40, 40, 55, 70-100, 70-100); egg found 1.3 m up on 5 mm barkless twig (*C. rossii* 60-100, 50, 100); egg found same tree, 1.6 m up on 6 mm barkless twig (*C. rossii* 0-100, 80); egg found same tree, 1.9 m up on 7 mm barkless twig (*C. rossii* 0-100, 0-100, 70-100); Crawford Gulch, Jefferson Co. Colo., June 23-24, 1992. Egg found 20 cm up on bark of 8 mm fallen twig 2 m from Douglasfir trunk (*Carex oregonensis* 0-100); eggs found under Ponderosa Pine canopies: egg found 20 cm up on bark of 6 mm fallen twig (*Carex pennsylvanica heliophila* 0-100, *Festuca saximontana* 30, 30, 50, 60-100, 70, 70); *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 30); egg found 20 cm up on bark of 1.5 mm fallen twig (*C. oregonensis* 0-100); egg found 15 cm up on bare broken end of 4 mm fallen twig (*C. oregonensis* 0-100, *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 25); egg found 10 cm up on bark of 1.5 cm fallen twig (*C. oregonensis* 0-100, 90); egg found 15 cm up on bark of fallen 1.2 cm twig (*C. oregonensis* 0-100, *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 20); egg found 40 cm up on bark of fallen 7 mm twig (*C. oregonensis* 0-100, *Agropyron* [*Elytrigia*] *repens* 70-100); egg found 30 cm up on bark of 5 mm tree branch (*C. pennsylvanica heliophila* 0-100, *Poa pratensis* sparse 15-100, *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 20, 30, 40, 80, 100); 2 eggs found on same tree 55 cm up on bark of 7 mm twig (*C. pennsylvanica heliophila* 0-100, *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 10-70, 40, 60, etc.); Falcon County Park, Jefferson Co. Colo., June 27, 1992. 2 eggs found under ponderosa pines: egg found 3 cm up on bark of side of 3 cm fallen branch (*Carex rossii* 3-35, 40, 90, 100, 100); egg found 30 cm up on bark of 3 mm branch (*C. rossii* 3-30, 8, 15, 15, 15, 30, 40 etc., *Agropyron* [*Elymus*, "*Sitanion*"] *longifolius* 80, *Oryzopsis exiguus* 80, *Koeleria macrantha* 100);

Lookout Mtn., Jefferson Co. Colo., June 29, 1992. Eggs found (all but one under ponderosa pines): egg found 70 cm up on 5 mm branch (Carex rossii 30, 35, 40, 40, 40-100, 80, 80, 100, 100, Oryzopsis exiguus 70-100); egg found 1.5 m up on bark of 3 mm Douglasfir branch (Carex pennsylvanica heliophila all around 0-100, Stipa comata 10, 10, 25, etc. common to 100); egg found 1 m up on bark of 3 cm branch (C. p. heliophila 0-100, Carex geophila 2-70, Poa pratensis 2-100, Koeleria macrantha 15, 20, 100, Stipa viridula 70, 100, Carex foenea 70); 2 eggs found 2 m up on bark of 4 mm branch (C. rossii 0-100); egg found 1.7 m up on bark of 2 cm branch (C. rossii 20, 20, 30, 25-70, 40, 50, Agropyron [Elymus, "Sitanion"] longifolius 4, 20, 20, 20, 25, 60, 70, 80, C. pennsylvanica heliophila 45-100, 90, Festuca saximontana 70, Oryzopsis exiguus 80, Koeleria macrantha common at 100, Poa pratensis 100); egg found 50 cm up on bark of 15 mm branch (C. rossii 0-5, 10, 10, 15, 20, 20-100, Stipa viridula 50, 55, 80, 100); egg found 30 cm up on bark of 12 mm branch (C. rossii 0-100, Stipa viridula 50, 60, 70, Bromus japonicus 25); Sawmill Gulch Rd. pass, Jefferson Co. Colo., June 29, 1992. Adults found at site where Carex brevipes is apparently the only sedge, hill SE Empire, Clear Creek Co., Colo., June 30, 1992. Egg found 50 cm up on bare 3 mm Douglasfir branch (Carex foenea all around 2-100, Koeleria macrantha 7, 10, 10, Carex rossii few 8-20, 40, 60, Poa nemoralis interior 70, 100), Chief Hosa Lodge, Jefferson Co. Colo., July 1, 1992. HOSTPLANTS: Carex surely is the principal host genus, although I have not yet tested it on larvae. Carex rossii is the main host in the lower foothills; Carex oeyerii is only an occasional host there because it is less common, but is likely to be the most common host in Montane and Subalpine Zones; Carex pennsylvanica heliophila is only an occasional host in the foothills because it usually grows in full sun rather than the shade under trees; Carex geophila is no doubt a rare host in the foothills (it is rare). Carex rossii is adapted to growing in the shade/partial shade beneath or near the Ponderosa Pine canopy on ridges and W- or E-facing slopes (Carex foenea occurs mostly in shade, whereas Carex pennsylvanica heliophila occurs in sunny spots), and O. chryxus only occurs in these forests and does not breed on open grassland (though males may hilltop to treeless hilltops). O. chryxus is the only butterfly in the foothills with a 2-year life cycle, perhaps because it is the only satyr which lives in the shade under trees where snow lingers in spring and summer temperatures are cooler. Females oviposit--flying only a little slower than normal--by finding abundant Carex rossii under or near the canopy of Ponderosa Pine trees, then they land on branches there, and evidently oviposit nearly always on the underside of branches (narrow or thick, barked or barkless, either dead branches fallen on the ground or dead or live lower branches still attached to the tree) preferably above the C. rossii. In 1990 I searched Carex rossii but found no eggs, obviously because females oviposit on twigs/branches/bark over the host, not on the host itself. In 1992, I found that eggs could be found quickly by searching for branches--fallen or not--just above a thick stand of the host, and turning over the fallen branches or peering up at the bottom of the attached ones. The first-stage larvae may crawl to the ground, but probably just drop off the branch then crawl to the host. Egg white, the valleys darker, small bumps around the top and strong vertical ribs.

Oeneis uhleri uhleri (Reak). Eggshell (compared to uhleri eggs) found on underside of Koeleria macrantha leaf (K. macrantha very common 0-1 m, Andropogon gerardii 5-20 cm, 30-60, Stipa comata 15, 20, 30, 50, 1m, etc. common, Andropogon [Schizachyrium] scoparius common 45-1 m), Mt. Zion, Jefferson Co. Colo., July 11, 1988. Oviposition 14:38 under dead grass blade 10 cm above Poa agassizensis clump (P. agassizensis abundant 0-100 cm, Carex probably pennsylvanica heliophila less common 20-100 cm, Agropyron [Pasopyrum] smithii common 10-100 cm); oviposition 15:02 under dead grass blade ~10 cm above ground over Poa agassizensis clump (P. agassizensis abundant 0-1 m, Carex probably pennsylvanica heliophila abundant 10 cm-1 m, Bromus [Bromopsis] lanatipes common 5-100 cm); Tinytown, Jefferson Co. Colo., May 18, 1989. Adults associated with Poa agassizensis, some Poa pratensis, Poa nemoralis interior, and Carex pennsylvanica heliophila, Tinytown, Jefferson Co. Colo., June 1, 1988, May 12, 18, 1989, May 30, 1990, June 11, 13, 1992. Egg found on Festuca idahoensis (F. idahoensis common all around, Stipa comata 50, 60, 80, 90, Carex? 40, Koeleria macrantha 80 cm away), SW Hot Sulfur Springs, Grand Co. Colo., June 24, 1989. Egg found 14:05 on Festuca idahoensis (F. idahoensis 0-10, 25-40 etc. common, Stipa comata 7, 10, 20, common 30-100, Carex vallicola 18-30, Agropyron [Elymus="Sitanion"] elymoides 20-50, 60); egg found 14:24 on Festuca idahoensis (F. idahoensis 25, common 40-100, Agropyron prob. [Elymus, "Elytrigia"]

dasystachyum 18, 35-50, Koeleria macrantha 30, 50, Carex sp. 25-30, 70, 80, 90, Stipa comata 30, 55, 55); SW Hot Sulfur Springs, Grand Co. Colo., June 28, 1989. Adults associated with Festuca idahoensis, Mt. Bross, 12000', Park Co. Colo., July 17, 1990. Poa agassizensis is probably the usual host in the Front Range foothills (based partly on association), and Koeleria macrantha is probably an occasional host; Festuca idahoensis is the main host in South Park and W Colo. My half-grown larvae died in lab. EGG white, the valleys turning reddish-white, the bumps on top larger than those of O. chryxus. FIRST-STAGE LARVA tan, top of T2-A1 bluish-tan, a middorsal brown line, slight dashes near it, a subdorsal ochre-brown line, dorsolateral ochre-brown band, a brown line along spiracles, rear forked; head yellowish-tan, seta bases & eyes black. 2ND-STAGE LARVA cream, a middorsal dark-green band (brown with whitish center on abdomen), then a broad cream band with weak reddish-brown line through it, a dark-brown line, broad cream band with weak gray line through it, a dark-brown broad band with tan line through it, a cream band, a brownish-red band with cream inside it, two reddish-brown tails; head light ochre-tan, seta bases black. HALF-GROWN LARVA tan, a blackish-brown middorsal line (stripe #1 of Scott 1986b), a broad cream band with red-brown line through it (#2), a red-brown band with tan center, another broad cream band with weak red-brown line through it (#3), a dark-brown band of striations edged with black lines (#4), a narrow cream band edged below by an orange-brown line, a light-brown band along spiracles (#5) (a brown irregular weak band just below spiracles), a cream-tan lateral ridge, a brown line (#6), underside brownish-tan; head tan with light-brown frontoclypeus and 3 vertical brown stripes on each side, eyes dark brown, eyes 2 & 3 in a cream patch.

Oeneis iutta reducta McD. Adults associated with Carex oeyerii; Hideaway Park, Grand Co. Colo., July 4, 1990.

Oeneis melissa melissa (Fab.) (= lucilla B. & McD.). Oviposition 12:10, she fluttered & landed at several spots near Carex rupestris drummondiana, then landed on sedges beside a 20-cm-wide low rock raised little above soil, and crawled over rock and laid egg on SE-facing slope of top of rock among lichens, egg was 4 cm from vegetation (C. r. drummondiana dead 5 cm, live 6, 8, 10, common 10-100, Trisetum spicatum spicatum 4-10, 25-30, 40-50, etc., Kobresia myosuroides 12, 20, 25, 40-100 common, Poa glauca 15, 30, 35, uncommon, Helictotrichon mortonianum 20, 20, 20, 20, 40, etc., Agropyron scribneri 10 [four small plants], 40, Luzula spicata 5, 10, 12, 12-20, 20, 40-100); Mt. Bross, "13,600", Park Co. Colo., July 17, 1990. Luzula (Juncaceae) is presumably unpalatable to larvae, but larvae can probably eat all the other plants; Carex rupestris drummondiana is probably a common host. Larvae eat Poa pratensis well in lab. My 4th? stage larvae died in lab, so this must be the hibernation stage during the second winter. EGG white. FIRST-STAGE LARVA band #1 dark-gray-green, #2 & 3 greenish-white (whitish-green on front 2/3 of body) with dark-gray-green dash in middle of each segment, a dark-gray-green line between #2 & 3, #4 greenish-tan, #5 & 6 greenish-white (lateral ridge pale, slightly darker just below lateral ridge), rear of A10 orange-tan; head orangish-tan with tiny brown dots, labrum brown, eyes black. HALF-GROWN LARVA-LARVA #1 continuous blackish, #2 brown (ventral part [2b] later develops black dashes), #3 cream (a weak brown band through it), #4 brown (later becoming light-brown between segments) with blackish-brown edges, #5 brown mottled with cream, lateral ridge cream-tan, #6 brown, underside light brown; head pale-brown with 6 weak brown stripes. LARVA 20 MM LONG (4th-stage?) light brown, #1 has black dashes alternating with tan bullet-shaped dashes, #2 cream but ventral 60% (#2b) tan with a blackish dolphin-shaped dash on each segment just above a longer blackish dash on lower edge of #2, #3 cream, #4 tan-brown (edged above with 2 blackish dashes on each segment [the rear longer], edged below by blackish line that is thinner posterodorsal to spiracle), #5 a narrow tan band (edged below by tiny brown specks) above a pale-tan-brown band containing spiracles, lateral ridge cream-tan, a brown line below it, #6-underside tan; head pale-brown with 6 dark-brown stripes.

Oeneis polixenes brucei (Edw.). A female was watched 9:30-10:30 in a N-facing hollow of tundra ridge, where she laid 4 eggs and voluntarily returned to the hollow several times after flying over drier surrounding areas; oviposition 9:40 on dead straw-colored horizontal Cerastium vulgatum stem (C. vulgatum a 7-cm-wide patch growing at edge of a 30-cm wide lichen-covered rock, Carex rupestris drummondiana 10-20, 30, 30, 30, 40, 40, 50, etc. to 100, Helictotrichon mortonianum 10, 30, 30, 50, 60, 80, Carex elynoides 20-30 common, 50, 70, 80, Festuca brachyphylla coloradensis 10, 35, 40, 40, 40, 50, 60, etc.,

Calamagrostis purpurascens 17-30, 30, 40, 40, 45, 50, etc., Poa glauca 20-30, 25, 40-100 common, Poa fendleriana var. longiliqua 75); oviposition 9:50 on edge of a 4-cm-tall NE-facing overhang in middle of a 30-cm-wide lichen-covered rock (Carex rupestris drummondiana 2 mm-30 cm, 30-100, abundant 25-100, Festuca brachyphylla coloradensis 7, 15, 35, 35-45, 45, 45, Calamagrostis purpurascens 30, 80, Poa fendleriana var. longiliqua 50); oviposition 10:05 on dead 0.5-mm-wide horizontal stem in Carex rupestris drummondiana patch at the long edge of a 30-cm-long lichen-covered rock (C. r. drummondiana 0-7, 10, 15, 15-20, 20, 25, etc., Luzula spicata 5, Festuca brachyphylla coloradensis 2, 5, 15, 30, 70, common 8-100, Calamagrostis purpurascens 20-40, 50, 50, 60-70, etc., Poa glauca 30, 30-100, Poa fendleriana var. longiliqua 40, 40); preoviposition 10:15, she landed on 30-cm-wide lichen-covered rock and crawled on a 6-cm-tall E-facing overhang in middle of rock, and bent abdomen to lay there under a Phlox cushion plant, but no egg was found perhaps because the spiny Phlox leaves prevented oviposition (Carex rupestris drummondiana 5-100, Helictotrichon mertonianum 15, 30, Calamagrostis purpurascens 30, 50, etc., Poa glauca 25, Festuca brachyphylla coloradensis 25); oviposition 10:20 on 1-cm-long pebble amid lichens on 50-cm-wide rock (Carex rupestris drummondiana 8-18, 10, 20, etc. common, Poa glauca 20-100, 25, 40, 40, 50, Festuca brachyphylla coloradensis 30, 45, 50, 55, Calamagrostis purpurascens 10, 15, 20, 25, 35-100, Helictotrichon mertonianum 50, 60); Loveland Pass, Clear Creek Co., Colo., July 20, 1989. Egg found (probably polixenes, doubtfully O. melissa) on dead Trifolium nanum flower west and next to 30-cm-wide lichen-covered rock on N-facing tundra hollow (Carex rupestris drummondiana 7, 15-30, 20-40, etc. common, Helictotrichon mertonianum 10-15, Festuca brachyphylla coloradensis 13, 20, 30-100, Calamagrostis purpurascens/Poa fendleriana var. longiliqua [mixed in collected herbarium specimen] 20-50, 30, Poa glauca 30-100, 40); (Carex rupestris drummondiana is the commonest plant near hollows where males perch); Loveland Pass, Clear Creek Co., Colo., July 22, 1989. Carex rupestris drummondiana is probably the usual hostplant, Festuca brachyphylla coloradensis may be eaten less often, and Helictotrichon mertonianum and the other grasses/sedges may be eaten sometimes. Larvae eat Poa pratensis well in lab, but ate no Carex rupestris drummondiana, though they could eat it in nature; more lab feeding preference studies are needed, but if larvae are like most other Satyrinae they can eat both sedges and grasses and show little preference. To oviposit, the female obviously searches for a big (~30 cm wide) rock, surrounded by sedges and grasses, which is level with the ground or sticking up only 5-8 cm or less (all the above rocks fit this description), and she prefers to lay the egg on the E-facing side of some miniature escarpment on the rock or on plants at the edge of the rock; this oviposition behavior evidently helps provide the egg with more heat and morning sun (afternoons are usually cloudy) for faster development (by using these clues, I was later [July 22, 1989] able to quickly find another egg in a similar situation). My 4th? stage larvae died in lab, so this must be the hibernation stage during the second winter. EGG white, turning slightly-purplish white. FIRST-STAGE LARVA pale-yellow-tan, with a purple (green after feeding) dorsal flush on front half of body, #1 light-orange-brown (paler in center), #2 & 3 creamy-tan-yellow with a light-orange-tan line between them, #4 orange-brown (paler in center) with brown edges, #5 creamy-tan-yellow with an weak orange-brown band along spiracles and a cream lateral ridge, #6 light-orange-brown, underside creamy-tan-yellow, two short blunt tails; head light ochre-yellow with three weak light-brown vertical bands, eyes black. 2ND-STAGE LARVA cream-tan (greenish-tan on front 2/3 of body after feeding), same as 1st-stage except an orange-brown line in middle of bands #2 & 3, #4 slightly darker, the cream-tan head now has the 3 usual bands light brown, eyes black. HALF-GROWN LARVA #1 alternating black, blackish, and brown rectangles, a cream line below them, #2 cream with numerous brown striations, edged by brown lines, #3 cream with a weak brown line through it, #4 blackish, edged below by a cream line, #5 mottled light-brown, a cream lateral ridge, #6 a brown band, underside light-brown; head light-orange-brown with weak mottled brown stripes like those of 18-mm long larva but weak. LARVA 18-MM LONG (4th-stage?) #1 alternating black and tan dashes, edged below by cream or tan line, #2a striated brown, #2b (present on T3-A5 only) has tan ovals in black band, edged below by cream or tan line, #3 striated light-brown, #4 solid black edged by cream or tan lines, #5 mottled brown, lateral ridge cream or cream-tan, #6 blackish-brown, underside light-brown (an irregular brown line just below #6), 2 short tails; head light-brown with 3 blackish-brown stripes, a few brown marks on side of frontoclypeus, a small brown crescent (concave upward) behind eye #1.

Anaea andria Scud. 17 larvae in rolled/tied leaves of large (30 cm) plants of Croton texensis reared to adults, SE Canon City, Fremont Co. Colo., Aug. 1, 1973. Oviposition C. texensis, Cottonwood Creek, Baca Co. Colo., July 3, 1973. Freshly emerged adult assoc. many C. texensis plants, Barr Lake, Adams Co. Colo., Aug. 17, 1985. Empty rolled-leaf larval nest found on C. texensis, and adults associated with it, Mangas Springs, WNW Silver City, Grant Co. New Mex., Aug. 8, 1986.

Apaturinae

Asterocampa celtis celtis (Bdv. & LeC.). Larva on underside of leaf near tip of branch of Celtis occidentalis, Columbia, Boone Co. Missouri, July 13, 1977. 1 nearly-mature larva found on Celtis occidentalis leaf (1f emerged July 2), Lincoln, Neb., June 15, 1991. Adults associated with C. occidentalis, Ash Hollow State Park, Garden Co. Neb., July 17, 1986. Adults associated with C. occidentalis, 5 mi. SW Elkhart, Polk Co. Iowa, June 18, 1987.

Asterocampa celtis antonia (Edw.). Ovipositions 12:45 on leaf, 13:20 on twig, 13:20 on berry, of Celtis reticulata, Rockvale, Fremont Co. Colo., July 23, 1972; the resulting larvae would not eat Ulmus pumila in lab. 3 larvae (stages 3-5) and pupal shell (shell attached by the cremaster to one end of a long silk mat that the shell is appressed to for its entire length beneath leaf) found beneath leaves of C. reticulata, Falcon County Park, Jefferson Co. Colo., July 14, 1984. 2nd stage larva found beneath leaf of C. reticulata, Falcon County Park, July 28, 1984. Pupal shell found on underside of C. reticulata leaf, the leaf was curled downward somewhat with silk and the pupa rested lengthwise pressed horizontally against leaf (not hanging from cremaster), Falcon County Park, Jefferson Co. Colo., July 27, 1987. One 5th stage larva on silk mat on bottom of C. reticulata leaf, the leaf bowed downward some, Tucker Gulch, Jefferson Co. Colo., June 13, 1988. Preoviposition 11:20 C. reticulata, Apex Gulch, Jefferson Co. Colo., Sept 3, 1988. 11 pupal shells found under C. reticulata leaves (on W side of tree only), Wheatridge, Jefferson Co. Colo., Aug. 27, 1991. Ovipositions 12:00 on twigs of planted Celtis occidentalis, commercial tree nursery, N. Washington St. X 64th Ave., Denver, Denver Co. Colo., June 29, 1973. EARLY STAGES (Jefferson Co. Colo.): EGG cream. MATURE LARVA light-green (bluish-green below lateral line) with numerous white seta bases, a subdorsal yellowish-white line runs from head (on rear of horn) to top of tail, on each abdomen segment a faint yellow-green middorsal area (a vestige of a pale-yellow middorsal spot present on front of each abdomen segment of 4th stage larvae)(the yellow-green area small on A1 and A8), a zigzag white line above spiracles on abdomen is formed of a squat V on each segment (the posterior arm of each V thicker and slightly-yellowish-white), a lateral line (consisting of yellow above white) runs from T2-A9, two tails; head green, with an anterior greenish-white vertical stripe extending from corner of labrum and curving and narrowing to medial side of horn base, another shorter greenish-white vertical stripe from dark eyes to anterior base of horn, the subdorsal yellowish-white line of body runs onto rear of horn, two brown-tipped antlers. PUPA light-(slightly-bluish)-green with numerous short white striations, wing veins white, a white ventral line beneath each horn, a white dorsal line runs from each of the two horns to near middorsal crest on T2, a yellow-white middorsal line extends along crest from T2 to cremaster, a tiny black spot is beside the yellow-white line on top of crest on front of each A3-8 segment, a white line along inner margin of wing and another along posterior margin of wing, a lateral white line below spiracles on A4-8, a subdorsal oblique white dash extending up and to the rear on each segment from A2-A8 (dash longer on A2, weak on A7-8, on A3-8 each dash is two-parted, the longer posterodorsal part enlarged into a white spot at its anteroventral end), a subdorsal spot on T2 has a white dash extending anteroventrally from it; attached by an elongated cremaster to a silk mat all along underside of leaf so that entire ventral part of pupa is appressed to leaf.

Asterocampa clyton. 6 egg clusters (145, 110, 149, 220, 105, 230 eggs), 1 cluster of ~60 1st-stage larvae (with heads aimed outward from cluster like besieged Musk-Oxen), 1 nearly-mature larva, 1 prepupa, 7 pupal shells, 6 pupae (3 emerged June 16 as 1m2f), all found on Celtis occidentalis; larvae silk leaves together some and rest under a leaf not bowed downward, pupae rest flat under leaf; many reared to adults; Lincoln, Neb., June 15, 1991. EGG cream. 1ST-STAGE LARVA greenish-cream, heart-line bluish-green, green lines next to heart and subdorsally, suranal plate brown; head dark brown, with light-brown extending down face. 2ND-STAGE LARVA cream, heart-band green, a green line next

to it, a green subdorsal band, greenish-cream sublaterally; head white, with black dorsal spot between horns, horns black with black extending laterally down from horns to side of head and neck (with three white bumps forming seta bases in this black patch), a large black pyramid on lower front of face, an inverted black anterolateral Y below horn, black around eyes, cream above labrum, brown below.

Nymphalinae
Limenitidini

Limenitis (Adelpha) bredowii (Gey.). Very fresh male caught Sept. 6, 1990, 2.5 months after a worn female was found June 24, 1990, which, together with the fact that these are the only L. bredowii I have ever seen in northern Colo., suggests that the female laid the egg that produced the male on Quercus gambelii, the only suitable host there; Tinytown, Jefferson Co. Colo.

Limenitis archippus archippus (Cramer). Oviposition 11:27 on top of leaf tip of Salix exigua interior (W), Box Elder Creek, Arapahoe Co. Colo., Aug. 11, 1984. Adults associated with S. exigua interior, Wood Duck Wildlife Area, Stanton Co. Neb., July 10, 1986. Adults associated with S. exigua interior, Helmer Myre State Park, Freeborn Co., Minn., June 16 and 19, 1986. S. exigua must be the hostplant in Weld, Pueblo, Fremont, and Saguache Cos. Colo. as it is the only willow/poplar growing at most sites. Unaccountably never found in the western Denver suburbs, though common along streams SE, E, and NE, and SW of Denver (along the South Platte River S to Chatfield Res. in S Jefferson Co.); evidently females will not oviposit on the variety of deciduous trees planted in the suburbs.

Limenitis lorquini weidemeyerii Edw. Oviposition 12:10 on leaf tip Amelanchier alnifolia, NW Hayden, Routt Co. Colo., July 10, 1972. Oviposition 10:37 on top of leaf tip of A. alnifolia, ovipositions 9:42 and 10:59 on top of leaf tips of Populus angustifolia, oviposition 10:45 on top of leaf tip of Salix irrorata (previously misidentified as S. lutea), all Cherry Gulch, Jefferson Co. Colo., July 17, 1984. Oviposition 11:03 on leaf tip of juvenile Salix amygdaloides with reniform stipules, Red Rocks, Jefferson Co. Colo., July 16, 1973. Oviposition 9:50 on leaf tip of Salix exigua (W), Golden Gate Can., Jefferson Co. Colo., July 8, 1978. Oviposition 9:45 on leaf tip of Prunus (Padus) virginiana melanocarpa, Red Rocks, Jefferson Co. Colo., June 25, 1978. Oviposition 11:35 on top of leaf tip of P. v. melanocarpa, Red Rocks, Jefferson Co. Colo., July 7, 1978. Oviposition 10:37 on top of leaf tip of P. v. var. melanocarpa, Falcon County Park, Jefferson Co. Colo., July 28, 1984. Older larva found on leaf of P. v. melanocarpa, S of Franktown, Douglas Co. Colo., May 18, 1985 Glenn R. Scott. Oviposition 8:50 upperside of P. v. melanocarpa leaf tip, ridge NE Crawford Gulch, Jefferson Co. Colo., June 15, 1988. Ovipositions 12:06, 12:13 on dorsal tip of P. v. melanocarpa mature leaves, oviposition 12:15 on dorsal leaf tip of Amelanchier alnifolia, E Mother Cabrini Shrine, Jefferson Co. Colo., June 15, 1992. Oviposition 10:05 on leaf tip of Holodiscus dumosus, Mt. Zion, Jefferson Co. Colo., June 17, 1981. Preoviposition on H. dumosus shrub for several minutes, Rose Peak, Greenlee Co., Ariz., July 28, 1986. Ovipositions 12:40, 12:45 on top of leaf tips of 7-cm-tall seedlings of Populus deltoides monilifera (= sargentii), Cherry Creek Reservoir, Arapahoe Co. Colo., Sept. 3, 1987. Oviposition 10:21 on projection of bug-chewed leaf upperside of planted P. deltoides deltoides tree, Arvada, Jefferson Co. Colo., June 26, 1991. Evidently polyphagous on a variety of deciduous shrubs and trees. The female always lands on top of a leaf, and while the leaf sags under her weight her body becomes nearly vertical as she lays an egg on top of the leaf tip. Egg olive-green. 1ST-STAGE LARVA brownish-olive-green mottled with white, the lateral area a bit paler with cream setae, a middorsal dark-olive-green band edged by narrow paler lines; head orange-brown with cream setae.

Nymphalini

Precis coenia (Hubn.). 47 ovipositions at 9:54, 10:18, 10:21, 10:50, 10:55, 10:58, 11:03, 11:09, 11:17, 11:33, 11:48, 12:30, 12:31, 12:48, 12:52, 13:08, 13:34, 13:52, 14:31, and 14:52, usually laid on underside of leaf petioles of small plants without inflorescences (but eggs were laid on plants with 4 and 7 inflorescences), often laid on the fuzzy new leaf buds at the plant center or on twigs or other debris near the plant center, and about 50 larvae found near or eating the plants, all on Plantago lanceolata, Point Richmond, Contra Costa Co. Calif., 1969, 1970, 1971, many larvae raised to adults in lab on P. lanceolata and on Plantago major. Oviposition is rapid; one Point Richmond female in nature laid 25 eggs in less than an hour, and the maximum in the lab was 166 in

38 a day; oviposition starts at about age 3 days and continues till day 22 at least in the lab, peaking at age 5-18. Individual females laid from 497-962 eggs in the lab (average 647, N=7). The hibernating stage is controversial (evidently no stage survives hard freezes), but at this mild-winter Calif. coastal site larvae were found in winter near the hostplants. Scott (1975d) reports ecology and movements at this site. Ovipositions 14:30 and 14:40, and two tiny larvae and two half-grown larvae found, all on young Castilleja sessiliflora seedlings, E of Renville County Park, Renville Co. Minn., July 13, 1986. Ovipositions 13:09, 13:10, 13:11 leaves and stem on top of Linaria vulgaris seedlings, Tinytown, Jefferson Co. Colo., July 1, 1991. EGG light green. 1ST-STAGE LARVA yellow-cream, gray on top, and blue-green on top of thorax, seta bases brown, suranal plate and collar blackish; head black.

Vanessa atalanta (L.). Larvae on Urtica dioica gracilis, SE Wetterhorn Peak, Hinsdale Co. Colo., Aug. 19, 1979. Four larvae in rolled leaves of U. d. gracilis, Tinytown, Jefferson Co. Colo., July 31, 1978. Larvae on U. d. gracilis (W), Sapello Can., San Miguel Co. New Mex., Aug. 23, 1978. Larva on U. d. gracilis, Mother Cabrini Shrine, Jefferson Co. Colo., Aug. 8, 1978. Oviposition 10:00 on leaf petiole of Rubus idaeus melanolasius next to U. d. gracilis, and two larvae on gracilis, Tinytown, Jefferson Co. Colo., July 30, 1978. Oviposition U. d. gracilis, Horse Creek, Elbert Co. Colo., July 3, 1978. Larva U. d. gracilis, Mother Cabrini Shrine, Jefferson Co. Colo., July 9, 1977. Mature larva in leaf nest of U. d. gracilis, Cherry Gulch, Jefferson Co. Colo., July 7, 1984. (Note: larvae from NW Big Turkey Cgd., Douglas Co. Colo., Aug. 26, 1985, reported by Scott [1986a], were actually Nymphalis milberti). 3 larvae found on U. d. gracilis, each in nest of leaves tied together (none with stem cut to let leaves droop), Barr Lake, Adams Co. Colo., Sept. 8, 1987. 3rd-stage larva found in U. d. gracilis leaf nest (leaf base eaten between veins to make leaf droop, leaf eaten to midrib 2/3 of way from base to tip to allow sides of leaf except tip to bend upward to enclose larva), Mother Cabrini Shrine, Jefferson Co. Colo., June 26, 1989. Egg found on U. d. gracilis leaf edge underside, Apex Gulch, Jefferson Co. Colo., July 18, 1989. Oviposition 10:46 on side of green fruit, egg found on upperside of small leaf edge, both on U. d. gracilis, Tinytown, Jefferson Co. Colo., July 25, 1989. Half-grown larva found on U. d. gracilis, Tinytown, Jefferson Co. Colo., July 1, 1991. 4 ovipositions: 10:02 side of tiny new whorl-leaf (1 of 4 subtending leaf base) at top of plant, 10:05, 10:05 on top of leaf edge, 10:08 side of young whorl-leaf, all on U. d. gracilis; Tinytown, Jefferson Co. Colo., June 16, 1992. 2nd stage larva in leaf nest (leaf folded up around larva) on U. d. gracilis, Walnut L. Wildlife Area, Faribault Co. Minn., June 23, 1985. 2nd stage larva in leaf nest (leaf folded up around larva) on U. d. gracilis, NE Alden, Freeborn Co. Minn., June 23, 1985. Mature larva found in drooping nest (the larva chews the petiole so the leaf droops, and then silks the leaf edges upward above the larva), three 7-mm larvae in folded-leaf nests, and two white wasp cocoons next to small Vanessa larval skins the wasp emerged from, all on U. d. gracilis, Helmer Myre State Park, Freeborn Co., Minn., June 16, 1986. 9 larvae found on U. d. gracilis leaf top nests; NE Alden, Freeborn Co. Minn., June 10, 14, 1990. 1 empty larval nest on U. d. gracilis; Halls of Humes Lake, Freeborn Co., Minn., June 15, 1990. NEST: Larvae live in a silk nest on top of leaf, the leaf drawn together above the larva, and older larvae chew partway through the petiole so the leaf droops. Early stages from Colo.: EGG green. FIRST-STAGE LARVA yellow, after feeding turning greenish-yellow. MATURE LARVA varies in different larvae from cream with tiny brown mottling, to mostly red-brown with fine cream mottling, or chocolate brown with tiny white dots, scoli the same in number as V. cardui (BD1 on A1-8 & a rudiment on rear of A8, BD2 on T2-A8, BSD on T2-A10, BL on A1-8 & tiny bumps on T1-3), scoli cream, but scoli bases are orange or yellow on front of body grading uniformly to cream on rear of body, underside brown, proleg tips reddish-brown; head black with many brown-tipped ochre or cream processes, each tipped by a brown seta. The cream bases of head processes, the gradual change in color of scoli from T2 to A10, and the weaker body pattern, distinguish V. atalanta from other Vanessa; the gradual change in color of scoli from T2 to A10 is perhaps phylogenetically related to the more drastic color change in some Polygonia (Scott 1988b). But there is great variation between larvae: One larva was cream all over with tiny brownish-red mottling, a wide subspiracular cream band (angled upward into a shallow inverted V between scoli), scoli cream, but scoli bases orange-ochre on front of body grading uniformly to cream on rear of body. One larva cream with sparse tiny blackish mottling, a dark-brown patch on each segment between BD2 & BSD, scoli cream-yellow but scoli bases yellow on front of body grading uniformly to cream on rear of body. One larva cream with fine blackish-brown mottling, a dark band (interrupted between segments) between BD2 and BSD scoli, scoli cream (except T2 scoli tipped by blackish-brown & T3

scoli slightly tipped) but scoli bases orange on front of body grading uniformly to tan on rear. One larva gray with fine brown mottling, a dark-brown band (interrupted between segments) runs between BD2 and BSD scoli, a cream band along BL scoli, the scoli all creamy-gray except BD1, BD2, BSD scoli have orange-tan bases esp. on front of body (AG-10 scoli gray without brown tint). Many larvae mostly red-brown because the cream mottling is much reduced, a cream subspiracular band (angled upward into a shallow inverted V between scoli) runs between BL scoli, weak darker bands (with less cream mottling) middorsally and between BD2 and BSD scoli and along spiracles, slight cream dashes in front of BD2 and BSD scoli (the cream dashes in front of BSD scoli large in some larvae), scoli cream (T2 scoli darker-tipped in some larvae but not in others), scoli bases orange on front of body grading uniformly to tan on rear. One larva chocolate brown with many tiny white dots, heart-band chocolate with cream scoli, white dots common beside it, a subdorsal band of cream dashes in front of cream scoli, a zigzag cream spiracular band, a lateral zigzag cream band, most scoli cream (except those on T2 black, on T3 tan at base & cream at tip).

Vanessa cardui cardui (L.). Larva on Cirsium centaureae (W), Tinytown, Jefferson Co. Colo., July 30, 1978. Larvae on Cirsium hesperium and Cirsium scopulorum, SE Wetterhorn Peak, Hinsdale Co. Colo., Aug. 19, 1979. 3 small larvae found in silk nests on Cirsium parryi leaf tops, Tinytown, Jefferson Co. Colo., July 4, 1991. 2 larval nests found on Cirsium incanum, Lakewood, Jefferson Co. Colo., Aug. 21, 1991. Ovipositions 10:40 leaf upperside, 10:40 leaf underside, on small (5 cm) C. incanum plant, Lakewood, Jefferson Co. Colo., April 28, 1992. Oviposition 10:40, 10:40 C. incanum leaf uppersides of small plant, Lakewood, Jefferson Co. Colo., April 28, 1992. Larva on Cirsium sp. reared, Echo Park, Dinosaur Nat. Mon., Moffat Co. Colo., June 11, 1973. Larva on Cirsium sp. (W), Rociada, San Miguel Co. New Mex., Aug. 23, 1978. Larva on Cirsium arvense reared, Echo Park, Moffat Co. Colo., June 11, 1973. Larvae on C. arvense, Tinytown, Jefferson Co. Colo., July 29, 1978 & July 30, 1978. Oviposition 11:15 C. arvense, Timnath, Larimer Co. Colo., Aug. 28, 1973. 4th stage larva found in silk nest on top of C. arvense leaf, a wasp emerged, Barr Lake, Adams Co. Colo., Sept. 8, 1987. Oviposition 10:23 on underside of C. arvense leaf, Wheatridge, Jefferson Co. Colo., July 7, 1988. 2 silk nests found on C. arvense leaf tops, Wheatridge, Jefferson Co. Colo., July 13, 1988. Mature larva in silk nest on top of C. arvense leaf, O'Fallon Park, Jefferson Co. Colo., Aug. 11, 1988. 5 empty leaf nests found on C. arvense leaf tops, Barr Lake, Adams Co. Colo., Sept. 6, 1988. 1 2-cm-long larva and 2 empty larval nests found on top of C. arvense leaves, N Fork Clear Creek, Gilpin Co. Colo., July 13, 1989. 1 half-grown larva found C. arvense; Red Rocks, Jefferson Co. Colo., June 18, 1990. Oviposition 12:21 on edge of C. arvense young leaf, another egg found on top of the leaf also; Tinytown, Jefferson Co. Colo., June 24, 1990. Half-grown larva on C. arvense; Wheatridge, Jefferson Co. Colo., July 7, 1990. 2 larvae found in silk nests on top of C. arvense leaves; Wheatridge, Jefferson Co. Colo., Aug. 6, 1990. 2 empty larval nests found on C. arvense; SW Greenwood, Custer Co. Colo., Sept. 5, 1990. 2 larvae found C. arvense leaves, Wheatridge, Jefferson Co. Colo., July 20, 1991. 2 larval nests found on C. arvense, Wheatridge, Jefferson Co. Colo., Aug. 22, 1991. 3 larvae in C. arvense nests, Wheatridge, Jefferson Co. Colo., Aug. 27, 1991. Larva C. arvense, Barr Lake, Adams Co. Colo., Aug. 30, 1991. Larva C. arvense, Wheatridge, Jefferson Co. Colo., Sept. 11, 1991. Pupa found in nest of several large Thermopsis divaricarpa (not a host) leaves loosely silked together but with a 1 cm gap between, C. arvense all around; Wheatridge, Jefferson Co. Colo., Sept. 2, 1991. Larvae on C. arvense and Cirsium vulgare, Rocky Flats, Jefferson Co. Colo., July 24, 1978. Many larvae reared from C. vulgare (G), Bear Creek, Chaffee Co. Colo., June 9, 1970. Oviposition 11:47 and larva on C. vulgare, Chimney Gulch, Jefferson Co. Colo., June 28, 1978. Larvae on C. vulgare, Tinytown, Jefferson Co. Colo., July 31, 1978. Oviposition C. vulgare leaf and old eggshells found, Golden Gate Can., Jefferson Co. Colo., Aug. 22, 1983. Oviposition 9:05 on top of leaf on midrib of C. vulgare, Corwina Park, Jefferson Co. Colo., July 4, 1986. Larva in silk nest on top of C. vulgare leaf, Barr Lake, Adams Co. Colo., Aug. 27, 1988. Three 7-mm-long larvae found on top of Cirsium ?vulgare leaves, Halls of Humes Lake, Freeborn Co., Minn., June 22, 1991. 2 half-grown larvae in silk webs on top of Cirsium canescens leaves, E Box Elder Creek, Arapahoe Co. Colo., June 1, 1989. One 2-cm-long larva, four ~5-mm-long larvae, on C. canescens, Box Elder Creek, Elbert Co. Colo., May 26, 1991. Oviposition 13:10 C. canescens leaf top, Smoky Hill Road, Arapahoe Co., Colo., May 19, 1992. Larva in silk web nest on top of Cirsium ochrocentrum leaf, Green Mtn., Jefferson Co. Colo., June 19, 1985. Larval nests with parasitoids on C. ochrocentrum leaves, Red Rocks, Jefferson Co. Colo., July 2, 1986. Two 3rd-stage larvae in silk web on top of C. ochrocentrum (W) leaves, Red Rocks,

40 C. ochrocentrum leaf, Green Mtn., Jefferson Co. Colo., Sept. 5, 1987. 3rd-stage larva found in silk nest on top of C. ochrocentrum leaf, Barr Lake, Adams Co. Colo., Sept. 8, 1987. 5 silk nests and dung piles seen on top of leaves of C. ochrocentrum, Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 9, 1987. 3rd & 4th stage larvae in silk nest on top of C. ochrocentrum leaves, Red Rocks, Jefferson Co. Colo., May 25, 1988. 6 mature larvae found in silk nests on top of C. ochrocentrum leaves, North Table Mtn., Jefferson Co. Colo., Sept. 22, 1988. Larvae feeding on C. ochrocentrum (previously misidentified as Cirsium undulatum), Red Rocks, Jefferson Co. Colo., June 30, 1973. Larva 1 cm long found in silk web on C. ochrocentrum leaf top; Apex Gulch, Jefferson Co. Colo., June 5, 1990. Empty larval nest found on C. ochrocentrum; Falcon County Park, Jefferson Co. Colo., July 18, 1990. Half-grown larva found in silk nest on top of C. ochrocentrum; Mother Cabrini Shrine, Jefferson Co. Colo., Aug. 30, 1990. Mature larva found C. ochrocentrum, E Crook, Logan Co. Colo., June 25, 1991. Big larval nest C. ochrocentrum, N fork Clear Creek, Gilpin Co. Colo., July 11, 1991. 4-mm-long larva found under C. ochrocentrum leaf in silk web, Coal Creek, Jefferson Co. Colo., July 15, 1991. 2 larvae found C. ochrocentrum, Coal Creek, Jefferson Co. Colo., July 16, 1991. Parasitoid found next to 3rd-stage larval skin on C. ochrocentrum, N fork Clear Creek, Gilpin Co. Colo., July 18, 1991. 3 larval nests on C. ochrocentrum, Apex Gulch, Jefferson Co. Colo., Sept. 5, 1991. Larva found C. ochrocentrum, Leyden Gulch, Jefferson Co. Colo., Sept. 11, 1991. ~10 larval nests on C. ochrocentrum, Crawford Gulch, Jefferson Co. Colo., June 10, 1992. ~20 small larvae in C. ochrocentrum leaf top nests, Tinytown, Jefferson Co. Colo., June 2, 1992. ~6 larval nests on C. ochrocentrum leaf uppersides, Apex Gulch, Jefferson Co. Colo., June 8, 1992. 1 larval nest C. ochrocentrum, Green Mtn., Jefferson Co. Colo., June 3, 1992. 4th-stage larva found in C. ochrocentrum leaf top nest, Guy Hill, Jefferson Co. Colo., June 22, 1992. Mature larva & 3 nests found on C. ochrocentrum, oviposition 13:18 on Cirsium arvense leaf; N fork Clear Creek, Gilpin Co. Colo., July 29, 1991. 2 larvae Cirsium arvense, 2 larvae Cirsium ochrocentrum, Tinytown, Jefferson Co. Colo., Sept. 4, 1991. Larvae on Cirsium undulatum (F), Central Plains Experimental Range, Weld Co. Colo., June 1976. Oviposition 9:30 on C. undulatum, Horsetooth Res., Larimer Co. Colo., May 8, 1977. Oviposition 11:37 on C. undulatum (W), Chimney Gulch, Jefferson Co. Colo., June 28, 1978. Larva on C. undulatum (W), Tinytown, Jefferson Co. Colo., July 30, 1978. Larva on C. undulatum leaf, Tinytown, Jefferson Co. Colo., July 2, 1980. Oviposition 12:10 C. undulatum, oviposition 12:15 on Anaphalis margaritacea, and 3 eggs (not in cluster) laid 12:05 on Artemisia frigida, all Russel Ridge, Douglas Co. Colo., June 3, 1973. Oviposition on Cirsium sp. and oviposition on A. margaritacea, Lookout Mtn., Jefferson Co. Colo., May 16, 1973. Oviposition 4 eggs 12:10 on A. margaritacea, Jarre Can., Douglas Co. Colo., June 6, 1973. Oviposition 11:42 on top of Carduus nutans macrolepis leaf, Tinytown, Jefferson Co. Colo., June 8, 1989. Oviposition 10:45 C. n. macrolepis leaf, preovip. 12:37 C. n. macrolepis; Tinytown, Jefferson Co. Colo., July 1, 1991. Oviposition 11:59 3 eggs (1 on phyllary 2 on leaf uppersides), & 4 other eggs found, 1 larva 5-mm-long found on leaf top, all on C. n. macrolepis; Tinytown, Jefferson Co. Colo., July 2, 1991. 2 half-grown larvae found on C. n. macrolepis leaves at base (on leaf tops no webs), Tucker Gulch, Jefferson Co. Colo., July 7, 1991. 4th-stage larva in C. n. macrolepis leaf top nest, Guy Hill, Jefferson Co. Colo., June 18, 1992. Mature larva found on C. n. macrolepis leaf top, ~15 larval nests found on Cirsium ochrocentrum, 4th-stage larva found in Lupinus argenteus (blue flowered var.) leaf nest, 3rd-stage and mature larva found on Cirsium incanum, Tinytown, Jefferson Co. Colo., June 17, 1992. Oviposition 13:00 C. n. macrolepis leaf upperside, 12 larval nests on Cirsium ochrocentrum, Tinytown, Jefferson Co. Colo., June 16, 1992. 3rd-stage larva found on C. n. macrolepis nest on growing plant top, 2 larvae found on Cirsium incanum leaf top nests, Mt. Vernon Canyon, Jefferson Co. Colo., June 15, 1992. ~12 larvae in leaftop silk nests on C. ochrocentrum, 3rd-stage larva in leaftop nest on C. n. macrolepis, Falcon County Park, Jefferson Co. Colo., June 27, 1992. 2 3rd-stage larvae (1 among new leaves on top of plant, 1 on leaf top) and 3 nests on C. n. macrolepis, 2 larvae and 1 nest found on Onopordum acanthium leaf tops, 2 eggs found on Lupinus argenteus (white flowered var.) leaf top bases, Tinytown, Jefferson Co. Colo., June 13, 1992. Ovipositions 13:26, 13:31, 13:32, 13:33, 13:34, 14:03 on Artemisia ludoviciana leaf undersides; 3rd-stage larva found on C. n. macrolepis leaftop nest (where it had moved from nest beside inflorescence); 1st-stage larva in Cirsium vulgare leaf top nest; 3rd-stage larva in Cirsium arvense leaf top nest; Sawmill Gulch Rd., Jefferson Co. Colo., June 29, 1992. Oviposition 12:23 Cryptantha minima leaf top, S Midway, Pueblo Co. Colo., May 6, 1992. 4th-stage larva inside silk web covering top of Malva neglecta leaf (larva died

because of an ant which was dragging larva partly out of the silk web), Cherry Creek Reservoir, Arapahoe Co. Colo., Aug. 13, 1985 (the larva formerly misidentified as Vanessa carve, but probably was V. cardui). Mature larva in silk nest of 3 M. neglecta leaves tied together, reared to adult, Wheatridge, Jefferson Co. Colo., Sept. 6, 1987. Half-grown larva in silk nest on top of M. neglecta leaf, Bandimere Speedway NE Morrison, Jefferson Co. Colo., Sept. 18, 1987. Empty silk web nest (probably cardui) found on top of M. neglecta leaf, Lakewood, Jefferson Co. Colo., Aug. 8, 1989. 3 silk nests with larval pellets found on top of leaves of Xanthium pennsylvanicum strumarium, but no feeding damage noted on leaves so not a valid hostplant record, Barr Lake, Adams Co. Colo., Aug. 23, 1989. Oviposition 12:23 on top of Cryptantha minima leaf, S Midway, Pueblo Co., Colo., May 6, 1992. Obviously Cirsium is the major host, and Carduus and Malva are suitable hosts, and the others may be. Carduus is not the most preferred host because in 1991-2 I saw fewer larvae on the plants than on Cirsium despite seeing numerous adults and plants. Larvae live inside a silk web on top of leaves, generally where the thistle leaf curls upward naturally. On Carduus, larvae seem to prefer to make nests on the growing plant tops.

EARLY STAGES from Colo.: Immatures do not hibernate in lab. EGG green. FIRST-STAGE LARVA greenish-yellow with gray top, suranal plate and collar blackish; head black. HALF-GROWN LARVA black, T1 brown on front and top part and a black collar with long cream hair, rear half of T2-A8 gray with thin transverse yellowish streaks, a black middorsal line edged by cream, scoli black (except scoli cream on A246 where BD1 and BD2 scoli are cream and SD scoli are reddish-ochre, and BD1 scoli on A357 are tan-cream), scoli bases are gray (except BD1 scoli cream on A246, BD1 scoli grayish-cream on A357, BD2 scoli cream on T3 A246, BSD scoli ochre on A2469), spiracles black in a gray round patch, a cream subspiracular band runs between BL scoli, a cream Y (one fork connected to subspiracular cream band below spiracle, the other fork connected to SD scoli above spiracle) extends rearward behind each abdomen spiracle, a cream dash angles forward & upward from each abdomen BSD scoli, underside of larva gray; head black with long cream hair. MATURE LARVA black, with long cream hair, T1 black, but cream-gray from just above the spiracle to underside, on T2-3 a large cream-gray patch includes BSD and BL scoli, a middorsal band (interrupted at BD1 scoli) is black with tiny gray spots, this band edged by yellow, on T3-A8 a rectangular gray area connects left and right BD2 scoli and touches rear of BD1 scoli (an anteriorly-convex black crescent mark is in this gray area just behind D1 scoli, though the middorsal part of this crescent is obliterated by gray on A4-8), two ochre (cream between T2-3 and T3-A1) transverse lines are on rear of A1-7 and have mottled gray-&-black areas between and beside them, the numerous scoli are cream with black spines as follows (but there is some variation between larvae in the amount of red on scoli bases, so that all scoli are light pink on base only and thus mostly cream on many larvae, and scoli are redder at base on some larva making all scoli look pinkish), middorsal BD1 scoli (present on A1-8) have bases creamy-gray except narrowly red on A246, subdorsal BD2 scoli (present on T2-A8) have reddish-brown bases (except brownish-red on T3, brown-gray on A1, and red on A246), a yellow dash extends forward from BD2 scoli on A2-8 (this dash extends forward as far as ochre transverse line on some larvae), supraspiracular BSD scoli (present on T2-A10) have brownish-red bases, a supraspiracular red-brown band is on abdomen (the band widest at BSD scoli, which have brownish-red bases, narrower & brownish-ochre between segments), a gray lateral band includes spiracles, a whitish-gray band below spiracles includes the whitish-gray subspiracular BL scoli (BL scoli present on A1-8, and present but short on T1-3), small bumps above the level of prolegs also have hairs, underside of larva gray; head black with small blackish processes, and long hair (each hair brown on basal half, cream on distal half), no horns. The alternation of color of scoli bases on abdomen segments is the same kind of alteration found in young Polytonia larvae (Scott 1988b), proving that these genera are closely related. PUPA golden-tan, with a lateral brown abdomen band, large subdorsal brown abdomen patches are blended into the ground color, many small brown dots on abdomen and top of thorax, a row of tiny brown dots on each side of antenna, a few brown postmedian dots on wing, a brown lateral dot on the middle of each leg, middle of leg may be golden, proboscis tip brown, many coppery-gold cones (large subdorsal cones on thorax and abdomen and smaller middorsal cones on abdomen, a large cone on anterior wing base, a small cone on wing base below T3, a small submarginal wing cone below A3), a black lateral band and a black dorsal band on cremaster, ventral part of cremaster has two brown clubbed ridges extending forward nearly to A8, middorsal brown line on cremaster. ADULT HIBERNATION: Fall adults on the Colo. plains and foothills do NOT migrate (they merely feed on Chrysothamnus nauseosus flowers), and adults are generally present in spring without observed migration (though

every 7 years or so a mass migration does fly up from SW U.S.-Mex.); therefore, adults must survive most winters in Colo. As proof, T. Cockerell once found an adult in Boulder, Boulder Co., Colo., in Jan.; and my experiments placing Sept.-Oct. adults of Vanessa, Polygona, and Nymphalis in the freezer indicate that V. cardui take just as long as the others to die (all of these die rather quickly in the freezer, apparently indicating that adults must require many weeks of gradually colder temperatures to develop frost-resistance).

Vanessa virginiensis (Drury). Larvae inside a nest of leaves webbed together with silk on Artemisia ludoviciana (W), Tinytown, Jefferson Co. Colo., July 29, 1978. Ovipositions 10:45 and 11:15 on top of leaves of two plants of Antennaria parvifolia (W) (this female ignored many A. ludoviciana plants), Corwina Park, Jefferson Co. Colo., July 3, 1986. 2 larvae found in silk web leaf nest on Anaphalis margaritacea, N Fork Clear Creek, Gilpin Co. Colo., Aug. 10, 1987.

Vanessa carye annabella (Field). Larva inside silk web on top of Malva sp. leaf, Berkeley, Contra Costa Co. Calif., Feb. 23, 1970. Rare in Colo., but evidently a native. Having now reared V. cardui from Malva neglecta (see above), I now think that the V. "carye" larva from M. neglecta at Cherry Creek Reservoir (Scott 1986a), Aug. 13, 1985, was probably V. cardui.

Polygona interrogationis (Fab.). Larva on Ulmus americana, Columbia, Boone Co. Missouri, July 13, 1977. Oviposition 12:14 on underside of Urtica dioica gracilis leaf, Helmer Myre State Park, Freeborn Co. Minn., June 16, 1986. Preoviposition on Humulus lupulus americanus (=neomexicanus), W Idledale, Jefferson Co. Colo., July 24, 1987.

Polygona satyrus (Edw.). Larva on underside of leaf of Urtica dioica gracilis, Tinytown, Jefferson Co. Colo., July 31, 1978. Many eggs (in clusters of 3-5) and larvae found beneath U. d. gracilis leaves, tiny larvae rest on the leaf underside without a nest and eat holes in it, older (stage 4-5) larvae rest in a leaf nest made by eating the leaf blade on both sides of the base then silking the leaf edges together below the leaf, and they eat the leaf from the edge, Mt. Vernon Historic Site, Jefferson Co. Colo. 5 June 1984. Preoviposition 10:12 near U. d. gracilis, Tinytown, Jefferson Co. Colo., May 16, 1988. Oviposition 10:47 2 eggs on leaf underside, 3 eggs found on leaf undersides, all on U. d. gracilis seedlings; oviposition 10:48 on underside of horizontal dead weed stem 40 cm from U. d. gracilis seedling; Tinytown, Jefferson Co. Colo., May 22, 1990. Oviposition 10:30 2 eggs beside each other under Bromus (Bromopsis) inermis leaf halfway up 15-cm-long leaf, 10 cm from 10-cm-tall U. d. gracilis seedlings, preoviposition several times under twigs near U. d. gracilis; Tinytown, Jefferson Co. Colo., May 11, 1991. Oviposition 14:08 2 eggs on underside of edge of Humulus lupulus americanus (=neomexicanus) leaf, 2 preovipositions on H. l. americanus; Wheatridge, Jefferson Co. Colo., July 7, 1990. Oviposition 12:33 2 eggs in column on H. l. americanus leaf underside, Wheatridge, Jefferson Co. Colo., July 20, 1991. Adults associated with H. l. americanus; Wheatridge, Jefferson Co. Colo., July 24, 1990. Female associated with H. l. americanus; Apex Gulch, Jefferson Co. Colo., June 4, 1990. Preoviposition 14:15 H. l. americanus; Chimney Gulch, Jefferson Co. Colo., July 26, 1990. Two flights occur in Colo. at least in the lower mountains and plains (perhaps just one in the higher mountains). Scott (1988b) reports the complete life history. Adults hibernate. Egg green. FIRST-STAGE LARVA green, becoming pale yellow, orange-brown on top of A1, 3, 4, 7, A8-10 somewhat brown, with blue-green dorsal flush on T1-3, A2, 4; head & collar black.

Polygona gracilis zephyrus (Edw.). Oviposition 11:12 on Ribes cereum petiole, Genesee Mtn., Jefferson Co. Colo., May 22, 1980. Larva on underside of leaf of R. cereum (W), Tinytown, Jefferson Co. Colo., July 31, 1978. Larva 15 mm long found on R. cereum branch tip, had eaten 3 whole leaves, Tinytown, Jefferson Co. Colo., July 2, 1991. Female fluttering about R. cereum, 1 mi. SE Shingle Creek, Jefferson Co. Colo., May 10, 1990. Larva found on underside of Ribes inermis leaf reared to adult, 3 mi. W Idledale, Jefferson Co. Colo., June 12, 1984. Egg found on R. inermis leaf reared to mature larva and pickled, Tinytown, Jefferson Co. Colo., June 2, 1984. Mature larva resting on top of R. inermis leaf & twig, leaves eaten nearby, E Empire, Clear Creek Co. Colo. July 2, 1988. Mature larva found resting with front part of body at right angles to remainder on underside of R. inermis branch; Tinytown, Jefferson Co. Colo., June 26, 1990. R. cereum is probably eaten most often, because it is very abundant; R. inermis is also popular (perhaps even preferred) but is only locally present. Two flights in the Colo. foothills, L June-E Aug. and Sep. overwintering to May; in the higher mountains there seems to be one flight L July overwintering to M June. High mountain adults often travel 400 m higher in the mountains after emergence to feed on flowers (adults were common in the alpine zone of Mt. Evans, Clear Creek Co. Colo., Aug. 3, 1984, where they fed on flowers and the hostplants were absent, although Ribes was not far away below timberline).

Nymphalis milberti also migrates to the alpine zone; P. g. zephyrus makes less of an altitudinal migration than N. milberti, and the other Polygonia, Nymphalis, and Vanessa evidently make no altitudinal migrations. Scott (1988b) reports the complete life history. Adults hibernate.

Polygonia progne progne (Cramer). Adult associated with Ribes inerme (W), 10 mi. NE Edgemont, Fall River Co., S.D., July 16, 1986. Adult associated with Ribes cynosbati L. (W), Monroe Can., Sioux Co., Neb., July 16, 1986. Early stages (from photos sent by Steven Spomer, Lancaster Co. Neb. Ribes missouriense): MATURE LARVA colors identical to those of P. progne nigrozephyrus Scott (1988b), including the change of dorsal ground color from ochre on thorax to cream on rear; the only difference seems to be the darker spines, esp. the sublateral spines which are brown (versus cream in nigrozephyrus & oreas) with orange bases, and the other spines are darker also (orangish-cream, versus cream), and the sublateral pale band seems slightly darker (ochre-cream versus cream). PUPA evidently identical to nigrozephyrus, light brown, most either pinkish-brown or pinkish-olive-greenish-brown.

Polygonia progne nigrozephyrus Scott. Adults associated with Ribes inerme, NE of Cedaredge, Delta Co. Colo., May 13-14, 21-22, 1984, females laid eggs on inerme in sleeves on wild plants and in the lab, and many larvae reared to adults on inerme. Adults associated with R. inerme, Pine Creek, Douglas Co. Colo., May 24, 1984. Adults associated with Ribes leptanthum, Williams Can., El Paso Co. Colo., May 16, 1984. Adults visit and feed on artificial rotten fruit/sugar/alcohol bait. Apparently one flight in Colo., L July overwintering to May, though some E July adults occur in the foothills. Scott (1984) described this ssp., and Scott (1988b) gave the complete life history and compared it with other Polygonia. Adults hibernate.

Polygonia progne oreas (Edw.). Larvae found on underside of leaves of Ribes sp. not divaricatum Douglas (plants with spiny fruits and stems) reared to adult, Duncan's Mills, Sonoma Co. Calif., June 1, 1974.

Polygonia faunus hylas (Edw.). Ovipositions 12:40 & 13:04, and 15 other eggs found, all on healthy twigs of Salix bebbiana (plants recollected and reidentified at the same site in 1988) shrubs (2 m tall) with leaves just emerging, the plants growing along a small creek, Russel Ridge, Douglas Co. Colo., June 3, 1973. 22 eggs found near or at the ends of S. bebbiana twigs having young leaves (length 3-15 mm, usually ~9 mm, versus 30-100 mm when mature) (12 eggs on side of twig, 1 egg on leaf bud cap, 4 on leaf underside, 3 on leaf tip, 2 on leaf base), some eggs were clustered (6 eggs were found alone, 3 clusters of 2 eggs, 2 clusters of 3 eggs, 1 cluster of 4 eggs), no eggs found on Alnus incana tenuifolia, no eggs found Salix monticola, Russel Ridge, Douglas Co. Colo. May 27, 1988. 2 eggs found (1 mm apart) on bud scale on end of twig with 12 mm leaves of S. bebbiana, other deciduous shrubs (S. monticola, Salix exigua, A. tenuifolia, Populus tremula tremuloides) had no eggs, Tinytown, Jefferson Co. Colo., June 1, 1988. 2 eggs found together on underside of S. bebbiana twig 1 cm from twig tip, the leaves just emerging (longest only 1 cm long, on 70-cm-tall plant), Tinytown, Jefferson Co. Colo., May 18, 1989. Egg found on underside of red twig of S. bebbiana (small plant 1/2 m tall) 2 cm from tip of twig which had 13-mm-long expanding leaves; Tinytown, Jefferson Co. Colo., May 22, 1990. About 5 eggs found on Ribes inerme leaves (one reared to adult), Tinytown, Jefferson Co. Colo., May 26, 1984. An average of 1.86 eggs is laid at each oviposition. Scott (1988b) reports the complete life history. Note: the OLDER LARVA head may not have an orange inverted-U in hylas as it does in Calif. rusticus (my one pickled Colo. larva and Clyde Gillette's [pers. comm.] Utah larvae lacked it). One flight L July overwintering to May. Adults hibernate.

Nymphalis milberti (God.). Larvae on Urtica dioica gracilis, Summit 7910, Iron Co. Utah, June 6, 1970. Larvae on U. d. gracilis, Lakewood, Jefferson Co. Colo., July 8, 1971. Larvae on U. d. gracilis, Texas Creek, Fremont Co. Colo., July 21, 1971. Larvae on U. d. gracilis, Hillside, Custer Co. Colo., July 16, 1971. Larvae on U. d. gracilis, Foxton, Jefferson Co. Colo., May 27, 1977. Larvae on U. d. gracilis, Tinytown, Jefferson Co. Colo., July 31, 1978. Larvae on U. d. gracilis, Crawford Hill, Jefferson Co. Colo., June 18, 1980. Larvae on U. d. gracilis, N fork Clear Creek, Gilpin Co. Colo., June 30, 1980. Egg masses (each about 100 eggs in a loose pile) and gregarious larvae found on leaves of U. d. gracilis, the older larvae rest on top of a leaf whose edges curl upward and together, Mt. Vernon Historic Site, Jefferson Co. Colo., June 5-7, 1984. Cluster of 1st stage larvae on leaf of U. d. gracilis, SE Golden Gate Can. State Park, Gilpin Co. Colo., June 17, 1984. Many larvae on U. d. gracilis, Apex Gulch, Jefferson Co. Colo., June 21, 1984. Many larvae on U. d. gracilis, Cherry Gulch, Jefferson Co. Colo., July 7, 1984. Many larvae (10 on top of leaf with leaf curled above larva, 1 beneath leaf with the leaf curled below larva)

44 on U. d. gracilis, Tinytown, Jefferson Co. Colo., July 15, 1984. Many larvae on U. d. gracilis, Tinytown, Jefferson Co. Colo., July 20, 1984. Three clusters of 4th-5th stage larvae on tops of U. d. gracilis (4 larvae were inside a drooping, base-clipped leaf nest, which probably had been made and abandoned by a Vanessa atalanta larva), Green Mtn., Jefferson Co. Colo., June 7-8, 1985. Larva on U. d. gracilis, Mother Cabrini Shrine, Jefferson Co. Colo., June 18, 1985. 20 2nd stage larvae on U. d. gracilis, NE Mt. Judge 9100', Clear Creek Co. Colo., Aug. 8, 1985. 1 mature larva eating top of plant, 1 larva in leaf nest (folded together above larva) with parasitoid pupa beside it, both on U. d. gracilis, NW Big Turkey Cgd., Douglas Co. Colo., Aug. 26, 1985 (misidentified as V. atalanta in Scott 1986). Oviposition 11:40 cluster of 89 eggs (cluster 5 mm wide, in several layers) on underside of leaf of small U. d. gracilis, Tinytown, Jefferson Co. Colo., May 15, 1988. ~60 larvae on U. d. gracilis, Van Bibber Creek, Jefferson Co. Colo., May 26, 1988. 5th-stage larva on top of slightly curled U. d. gracilis leaf, Tinytown, Jefferson Co. Colo., June 2, 1988. Larva (prepupa) found on Ribes inerme (the larva wandered to this) near defoliated U. d. gracilis, E Empire, Clear Creek Co. Colo., July 2, 1988. Oviposition 14:17 ~145 eggs on U. d. gracilis leaf underside, Apex Gulch, Jefferson Co. Colo., April 21, 1989. ~40 ~3rd stage larvae on silk web on basal part of U. d. gracilis leaf; larvae evidently have an ant-repellent chemical, probably produced by the ventral neck gland: 5 ants (red, with black abdomen) refused to walk onto the larval leaf (they walked onto leaf petiole 5X then backed away), then I placed one ant on the leaf tip and it refused 5X to walk near the larvae over a 2-minute period, then when I placed this ant on top of larvae it instantly dropped off of leaf; Tinytown, Jefferson Co. Colo., June 6, 1989. 2 larvae 12 mm and 17 mm long found on top of curled up and tied U. d. gracilis leaves, ~6 similar shelters found, Tinytown, Jefferson Co. Colo., July 25, 1989. Oviposition, she landed and tested many young low U. d. gracilis plants 10:50-11:20 before laying, then laid ~100 eggs 11:30-11:52 in an unstructured pile on U. d. gracilis leaf underside of plant 10 cm tall; another cluster of ~90 eggs in unstructured pile found U. d. gracilis leaf underside; Tinytown, Jefferson Co. Colo., May 22, 1990. 5 clusters of half-grown larvae found on top of U. d. gracilis leaves; Tinytown, Jefferson Co. Colo., June 21, 1990. Several older larvae found on U. d. gracilis; Tinytown, Jefferson Co. Colo., July 2, 1990. ~40 4th- & 5th-stage larvae found on U. d. gracilis, evidently proving the existence of a second generation; Tinytown, Jefferson Co. Colo., Aug. 29, 1990. Mature larvae found on U. d. gracilis; Tinytown, Jefferson Co. Colo., Sept. 6, 1990. ~50 1st-stage larvae in cluster on U. d. gracilis, Tinytown, Jefferson Co. Colo., July 1, 1991. 1 ~4th-stage & 2 mature larvae found on U. d. gracilis, Tinytown, Jefferson Co. Colo., July 31, 1991 (1 adult female found also). ~50 2nd-stage larvae found on top of leaf base (breaking leaf down so it drooped), mature larva found on other leaf, both on U. d. gracilis, Tinytown, Jefferson Co. Colo., June 13, 1992. PHENOLOGY AND MIGRATION: Evidently there is usually only one yearly flight in Colo.; first generation overwintering adults mate and lay eggs in spring, then the larvae are common on the hosts in June-M July, and adults emerge in L June-July, when they seem to migrate high in the mountains to feed on flowers in L July-Aug. (adults are common on flowers in the alpine zone throughout the state, where the host does not grow), then in Sep. they evidently return to the lower mountains to hibernate. The usual absence of Aug. larvae, and the abundance of adults in the alpine zone where the host is absent, seem to prove this altitudinal migration. Further proof: the closely related Nymphalis urticae L. (Yamamoto 1976) and Inachis io L. (Hasegawa 1975) also make altitudinal migrations in Japan. However, in 1990 there was at least a partial 2nd generation in the foothills & upper plains of Jefferson Co. Colo., based on adults found (Crawford Gulch, June 20 fresh male, July 5 fresh adult seen; Tinytown June 21 fresh female; Wheatridge July 14 slightly worn male), and larvae found at Tinytown in late Aug.-early Sept. 1990 which would produce adults in Sept. Adults hibernate. EARLY STAGES from Colo.: EGG green. 1ST-STAGE LARVA yellowish-cream, turning bluish-green anteriorly after feeding, suranal plate & collar black; head black. 2ND-STAGE LARVA yellowish-cream, a subdorsal band of irregular brown crescents, seta bases brown, suranal plate & collar black; head black. MATURE LARVA black with numerous tiny white dots (dots more common on rear of each segment, where they are arranged in transverse bands, and a short streak of white dots extends anteriorly from BD2 scoli), a middorsal black band (lacking white dots), white dots are common beside this black band forming a whitish band, a cream band runs between BSD scoli just above spiracles, behind BSD on A1-7 an orange-red streak extends anterodorsally from this white band almost to BSD, and a white streak extends anteroventrally from this white band to nearly below spiracle, a gray-centered black band includes spiracles, a cream subspiracular band, underside creamy-gray except a

large reddish-brown spot is just anteroventral to each BL scoli on T2-A7, a midventral brown band, many scoli (black BD1 on A2-A8 & a rudiment on "A9", black BD2 on T2-A8, black BSD on T2-A10, cream BL on A1-A8 (extremely tiny on T1-3, tiny processes with setae below BL scoli); head black with long pale hairs, many short white processes tipped by pale hairs, one short black dorsolateral process is also tipped by a pale hair. PUPA golden-tan or golden-gray-tan, a light-brown lateral abdomen band, a wide light-brown midventral abdomen band, the abdominal cones tipped by coppery-gold.

Nymphalis californica (Bdv.). 70 half grown to mature larvae on Ceanothus fendleri, June 17 & 23, 1980, and egg cluster of 80 eggs found on underside of leaf, July 11, 1980, all Apex County Park, Jefferson Co. Colo. Two larvae on C. fendleri, Ralston Butte, Jefferson Co. Colo., June 20, 1980. About 70 2nd-4th-stage larvae gregariously feeding on C. fendleri, Red Rocks, Jefferson Co. Colo., May 25, 1988. ~70 3rd-stage larvae found on one C. fendleri branch, they eat leaves on the branch tip then eat toward the base then move to another branch, Tinytown, Jefferson Co. Colo., June 2, 1988. Preoviposition 11:32-11:56 on C. fendleri, Indian Peak, Jefferson Co. Colo., April 21, 1989. Larvae of N. antiopa & N. californica do not make silk nests. There is evidently only one yearly flight in Colo., July overwintering to May, because summer adults feed on mud etc. but do not show mate-locating behavior (hilltopping in this species) which the spring adults do display. Adults hibernate. Early stages from Colo.: MATURE LARVA black with many long cream hairs & many tiny cream dots, these dots grouped into 3 transverse rows on rear of each segment, a middorsal black band (interrupted by the cream BD1 scoli) is sharply-edged by a light-yellow band (this band is wide in some larvae, narrow in others), a dark band (caused by absence of white dots on front of each segment, producing a black area) runs between BD2 & BSD scoli, a cream band (narrowed to a line just above BL scoli) runs between BL scoli, a red-brown band runs below that band, underside cream, true legs black, side of anterior 8 prolegs light-red-brown, side of A10 proleg blue-black, a brown midventral band, all scoli have black-tipped spines, most scoli are light brown (light-orange-brown in some larvae), BD1 scoli (present on A1-8, & a rudiment on rear of "A8") are yellow-cream with a light-brown tip and sometimes a very narrow red-brown ring around base, except BD1 tan on A8, BD2 scoli (present on T2-A8) are black on T2 with reddish-black base medially and blue-black base laterally, brown with red-brown base on T3, light-brown with red-brown base on A1-6, brown on A7, blackish-brown on A8, BSD scoli (present on T2-A10) brown on T2 & A7, light-brown on T3-A6 with narrow red-brown base, black on A8-10, BL scoli (present on A1-8) are light-brown with cream base on A1-6, brown on A7, black with brown base on A8; head blue-black with many pale hairs, many black processes (some fairly long on top of head including two close together which almost form a rudimentary horn) are tipped by pale hairs, about 5 tiny white bumps on top of head are topped by a pale hair. PUPA light-gray (with dorsal areas of A1-4 gray-tan) or tan or dark-brownish-gray or grayish-brown or reddish-brown or gray-black in different pupae (the lighter pupae tend to have dorsal areas of A1-4 browner), all pupae have two short horns on head (each horn has black on the sides), a keel on T2 (with black on the side of the tip), two small black-tipped cones on wing base, a small subdorsal black-tipped cone on T2, small black-tipped middorsal and large subdorsal abdomen cones, the subdorsal abdomen cones on A2-7 are black distally with an orange tip, the subdorsal cones on T3 & A2 have a wide white base with black tip (the very tip orange on A2 cone), a white spot is where the subdorsal T1 cone would be (it is absent), a pale-brown-edged middorsal abdomen band, a lateral brown abdomen band, a brown midventral abdomen band, a black dot just dorsal to and a black dot just posteroventral to each black abdomen spiracle, wing has a blackish spot on tornus and a row of tiny postmedian dots, cremaster has a wide black middorsal stripe & a wide black midventral stripe & a black lateral stripe & a long subdorsal orange ridge and a long subventral orange ridge, all on cremaster.

Nymphalis antiopa (L.). Larvae on Salix exigua, Mirage, Saguache Co. Colo., Aug. 9, 1970. Larvae on S. exigua, Lake Creek Cgd., Custer Co. Colo., Aug. 24, 1970. Larvae on S. exigua, WNW Crestone, Saguache Co. Colo., July 22, 1971. Larvae on S. exigua, Pruess Lake, Millard Co. Utah June 17, 1972. Oviposition from before 10:35 (when female was spotted) to 12:08 (when she finished and flew away) ~146 eggs in several layers in a 12x3 mm cylindrical mass around 1.3 mm wide stem near top of 1/2 m tall S. exigua shoot, she rested upside down on stem during oviposition, N Fork Clear Creek, Gilpin Co. Colo., July 16, 1988. Cluster of ~257 eggs found on S. exigua forked stem (the cluster was in two parts, the upper part was 86 eggs 70% of way around twig just above fork, the other part was 78 eggs 70% of way around twig just below and at fork, fully joined to ~93 eggs all the way around twig base angling up and away from

46 fork)(19 eggs had hatched, half the eggs were dark red, half were black with larva visible within); N Greenwood, Douglas Co. Colo., July 23, 1990. Mature larva found wandering 10 m from S. exiqua plant which had ~4 mature larvae and traces of feeding and cast skins of ~50 departed larvae; Tinytown, Jefferson Co. Colo., Aug. 5, 1991. Larvae reared Salix amygdaloides, Central Plains Experimental Range, Weld Co. Colo., June 28, 1976. ~50 5th stage larvae defoliating S. amygdaloides, ~5 larvae wandered to adjacent S. exiqua and ate it, ~6 larvae wandered to adjacent small Populus deltoides monilifera (=sargentii) and ate it, Lakewood, Jefferson Co. Colo., June 4, 1988. 50 larvae on Salix bebbiana (W), N fork of Clear Creek, Gilpin Co. Colo., 2 July 1978. Larvae on Ulmus pumila, Lakewood, Jefferson Co. Colo. 1961. Larvae on U. pumila, Fort Collins, Larimer Co. Colo., 27 June 1976. Cluster of 30 4th-stage larvae found on Celtis reticulata (the larvae had eaten ~20 whole leaves), Lookout Mtn., Jefferson Co. Colo., June 6, 1991. Larvae on C. reticulata leaves found by Steven Cary, Ute Lake State Park, Quay Co. New Mex., 14 May 1985. Diseased dead (almost certainly sprayed with insecticide) half-grown (thus having fed for some time) larvae found on planted Celtis occidentalis, Northern Nursery, N Washington St. X 64th Ave., Denver, Denver Co. Colo., June 29, 1973. ~10 larvae crawled down C. occidentalis trunk onto sidewalk after defoliating one branch, Lakewood, Jefferson Co. Colo., June 10, 1988. Ovipositions and even larvae of N. antiopa are seldom seen, obviously because a female probably lays only 1 or 2 egg clusters during her life. There is undoubtedly only one generation in the higher mountains, as in Europe (Roer 1970), but in the foothills and plains two flights occur, because every year fresh adults appear L June-M July, and I have often seen these fresh adults chasing each other in mate-locating behavior (perching along creeks and chasing other butterflies) (hibernating adults generally show mate-locating behavior only in spring). And the egg cluster found July 23, 1990, and an oviposition seen by other people in Denver July 1990, are conclusive proof that two generations occur on the plains and lower foothills. And while discarding alcohol vials of preserved insects that I had collected during an entomology course field trip, I found a preserved N. antiopa larva from the second generation (White Rocks, Niwot, 5100', Boulder Co., Colo., Oct. 4, 1967). The larvae found Aug. 24 and July 22 represent offspring perhaps of the midsummer flight, or perhaps of very late hibernators, because the localities are higher than the foothills. If only one flight occurred in the foothills, then the adults would have to diapause and go into hiding in E Aug., then reappear in M Sept.-Oct. and feed on flowers before hibernating; there is no evidence for this hiding, and N. antiopa rarely occurs in the alpine zone so does not have altitudinal migrations like N. antiopa. Adults hibernate. MATURE LARVA (Colo.) black with numerous tiny white dots (these dots arranged in transverse rows on rear part of each segment), many long cream hairs, a middorsal black band (constricted or interrupted by the red spots), a middorsal red spot on T3-A7 (small on T3, successively larger on A1-2, largest on A3-7)(each red spot is behind scoli BD1 and extends laterally to BD2 scoli and is connected anteriorly to the red left and right bases of the BD1 scoli [the front base of the BD1 scoli is black], each red spot has a black transverse streak in it behind the BD1 scoli, and each red spot is partly or completely divided by the middorsal black band), a black circular subdorsal area occurs below each red spot, a longitudinal row of black spots (black because lacking white dots) near the segment joints runs along the body between BD2 & BSD scoli, the anterior 8 prolegs red, anal prolegs black, true legs black, a brown midventral band, long scoli present (BD1 on A3-8, BD2 on T2-A8, BSD on T2-A10, BL on A1-A8), scoli black except BD1 scoli on T2-A8 have base of scoli shaft orange; head black with long tan hairs, short black processes, no horns.

Melitaeini

Euphydryas chalcedona/anicia chalcedona (Dblidy.). Larvae on Castilleja sp., Grizzly Flat, El Dorado Co. Calif., March 24, 1974. Many larvae on Castilleja foliolosa (H), some larvae on Castilleja martinii (H), Monticello Dam, Yolo Co. Calif., March 16-17, 1974. Larvae on Scrophularia californica and Castilleja sp. bracts, Alum Rock Park, Santa Clara Co. Calif., March 6, 1970. Larvae on top of leaves of S. californica, Tilden Park, Contra Costa Co. Calif., March 21, 1970 J. Scott and P. Opler. Larvae feeding on S. californica (M), Foote Crossing, Nevada Co. Calif., May 12, 1974. Two mature larvae feeding on Orobancha fasciculata var. franciscana, other larvae feeding on S. californica, Castilleja (green-leaved sp.), and Mimulus sp., 5.4 mi. SW Allegheny, Blue Ravine, Sierra Co. Calif., May 12, 1974 J. Scott & Ralph Wells. Larva feeding on Penstemon antirrhinoides, Chili Bar, Placer Co. Calif., April 14, 1974. Larva feeding on P. antirrhinoides, Jerseydale, Mariposa Co. Calif., April 20,

Euphydryas chalcedona/anicia wheeleri (H. Edw.). Larva on bracts of Castilleja chromosa, SW Pulpit Rock, Montezuma Co. Colo., May 9, 1983. MATURE LARVA (Pulpit Rock) black, all scoli have black needles, middorsal spines ochre in an orange ochre-rimmed patch, two small ochre middorsal spots (the posterior spot smaller) on each segment beside a middorsal black line, subdorsal spines black, supraspiracular spines ochre on abdomen, black on thorax, all supraspiracular spines in an orange ochre-rimmed patch, two ochre spots (the posterior tiny) between adjacent supraspiracular patches, lateral (subspiracular) spines black on abdomen, ochre on thorax, a few tiny ochre lateral dots, sublateral spines ochre, a few small sublateral ochre spots, underside blackish-brown, a midventral blackish-brown line on either side of which is an ochre patch on abdomen (on proleg segments the ochre patch is on anterior base of proleg); head black.

Euphydryas chalcedona/anicia bernadetta (Leuss.). Adults associated with Castilleja flava (a few Penstemon strictus also present at site), SW Hot Sulfur Springs, Grand Co. Colo., June 30, 1989. Adults associated with C. flava, 1/2 mi. N Silverthorne, Summit Co. Colo., July 3, 1989.

Euphydryas chalcedona/anicia anicia (Dblidy. & Hew.) ("brucei" Edw.). Pupal shell found on Castilleja occidentalis leaf, and adults associated with this plant (no other Scrophulariaceae nearby), Loveland Pass, Clear Creek Co., Colo., July 22, 1989. One older larva on Potentilla sp. (no feeding damage on plant, evidently just a wandering larva), Mt. Sherman, Park Co. Colo., July 17, 1980. About 20 half-grown apparently-diapausing larvae on underside of rocks apparently in diapause, Uncompahgre Peak, Hinsdale Co. Colo., July 18, 1980; the presence of adults and half-grown apparently-diapausing larvae in abundance at the same midsummer time proves that in the alpine zone many individual life cycles are biennial or longer. Half-grown larvae hibernate. OLDER LARVA (Mt. Sherman) black with many ochre dots, spines black, middorsal scoli have orange bases, a middorsal black line is edged by an ochre band of irregular spots, supraspiracular spines with orange bases, in an ochre band of irregular spots, sublateral spines ochre-brown on T2-abdomen, in an ochre band of irregular spots, underside blackish-brown with ochre spots, a midventral blackish-brown band edged on A1-2 and A7-9 by an ochre band and spots, proleg bases ochre; head black. MATURE LARVA (Uncompahgre Peak) same as Mt. Sherman larva, but the bands on body are gray (not ochre); the Mt. Sherman larva was pickled, so perhaps it was gray in nature as well. PUPA (Uncompahgre Peak, Loveland Pass) white with many black streaks and marks, and middorsal, subdorsal, supraspiracular, subspiracular, and subventral rows of orange-behind-black spots (the latter three rows only on abdomen), the first three rows of spots are on cones (each cone except the anterior middorsal cones has a black crescent clasping its anterior base and an orange semicircle on the anterior top).

Euphydryas chalcedona/anicia anicia-capella ("eurytion" [Mead]). Larva on Castilleja integra (G) bracts raised to adult, NE Rosita, Custer Co. Colo., June 1970. PUPA (Rosita) white with brownish-ochre marks and tiny black markings (pupal markings shaped like those of ssp. brucei including the black-and-orange dorsal bumps, but black markings much smaller esp. on wing), base of eclosion flap mostly blackish-brown.

Euphydryas chalcedona/anicia capella (Barnes). 40 larvae in silk web on Penstemon virgatus asagravi, Apex Gulch, Jefferson Co. Colo., Aug. 13, 1978. Larvae inside silk web covering nearly-defoliated plants like a nylon stocking on P. v. asagravi (W), Idledale, Jefferson Co. Colo., Aug. 8, 1978. Three clusters of eggs and larvae on P. v. asagravi (W), Tinytown, Jefferson Co. Colo., Aug. 10, 1978. Two egg clusters on P. v. asagravi, Golden Gate Can., Jefferson Co. Colo., July 3, 1980. 20 eggs found on underside of leaf of P. v. asagravi, Tinytown, Jefferson Co. Colo., July 21, 1984. Two silk nests containing 2nd-stage larvae on Penstemon glaber (= alpinus) (W), Tinytown, Jefferson Co. Colo., July 29, 1978. Seven egg clusters on underside of leaves of P. glaber, Tinytown, Jefferson Co. Colo., July 2, 1980. Cluster of ~40 ~2nd-stage larvae found in silk nests (the whole plant covered with some silk) on P. glaber, 3 other plants had no larvae, several P. v. asagravi plants had no larvae, some Penstemon virens had no larvae, some Verbascum had no larvae, a few Castilleja miniata had no larvae, Chief Hosa Lodge, Jefferson Co. Colo., Aug. 16-17, 1989. No larvae seen on 1 P. glaber, ~30 P. virens, ~40 Linaria vulgaris, Tinytown, Jefferson Co. Colo., Aug. 21, 1989. Cluster of ~50 1st-stage larvae found in big silk web around several Linaria genistifolia dalmatica leaves, no larvae were found on ~30 P. virens and ~20 C. miniata, Tucker Gulch, Jefferson Co. Colo., July 13, 1989. 33 clusters of larvae (most 2nd, some 3rd, some 1st stage) in silk nests found on L. g. dalmatica leaves, most clusters 1/3 to 2/3 from base to top of plant, some clusters covering several leaves; no

48 larvae found on ~150 C. miniata or ~150 P. virens or ~15 Verbascum plants; Tucker Gulch, Jefferson Co. Colo., July 27, 1989. 9 clusters of 1st-3rd-stage larvae found on L. q. dalmatica (a million or more plants occurred), 2 clusters of 1st-2nd stage larvae found on two P. glaber plants (only 3 plants found, proving that this is a favorite host), ~45 C. miniata plants had no larvae, ~62 Castilleja integra plants had no larvae, ~15 Verbascum plants had no larvae, ~50 P. virens plants had no larvae, Tucker Gulch, Jefferson Co. Colo., July 31, 1989. 13 clusters of 1st-3rd-stage larvae found on L. q. dalmatica, ~15 C. integra plants had no larvae, ~40 C. miniata plants had no larvae, ~25 P. virens plants had no larvae, 3 P. glaber plants had no larvae, ~30 Verbascum had no larvae, Crawford Hill, Jefferson Co. Colo., Aug. 1, 1989. 1 cluster of ~2nd-3rd-stage larvae found on L. q. dalmatica (plants very common but only 1 cluster seen), 10 C. integra plants had no larvae, 2 Verbascum had no larvae, Mt. Zion, Jefferson Co. Colo., July 29, 1989. 1 cluster of ~20 ~2nd-stage larvae found in curled dried L. q. dalmatica leaf, the lower 2/3 of plant eaten & dried, the only cluster seen among ~300 plants checked, Van Bibber Creek, Jefferson Co. Colo., Aug. 8, 1989. No larvae found on many L. q. dalmatica, some Verbascum, some P. virens, E of Shingle Creek, Jefferson Co. Colo., Aug. 17, 1989. No larvae seen on many L. q. dalmatica, some L. vulgaris, a few P. virens, ~15 P. v. asagravi, some Verbascum, 1 C. miniata, Apex Gulch, Jefferson Co. Colo., Aug. 24, 1989. Of 11 P. glaber plants examined, 1 had empty mature larval web nest covering a 5-cm-long area of leaf & stem, 3 had 1 egg cluster, 2 had 2 egg clusters, 1 had 5 egg clusters, 4 had none, (4 of the 12 egg clusters were light reddish, perhaps due to disease); 1 L. q. dalmatica plant (of many examined) had 1 cluster of yellow eggs on leaf underside and 2 clusters of red-brown eggs on leaf upperside (the only clusters noted on leaf upperside, all others were on underside); the 4 preserved clusters had 44, 84, 112, and 130 eggs; Crawford Hill, Jefferson Co. Colo., July 1, 1990. Cluster of ~10 half-grown larvae in curled L. q. dalmatica leaves silked shut; Mt. Zion, Jefferson Co. Colo., Aug. 14, 1990. Cluster of ~30 1st-stage larvae in 2 silked L. q. dalmatica leaf tops; Beaver Brook Trail, Jefferson Co. Colo., Aug. 14, 1990. ~15 larvae found in curled leaf nest of L. q. dalmatica; Apex Gulch, Jefferson Co. Colo., Aug. 20, 1990. Cluster of 20 larvae found on L. q. dalmatica; Apex Gulch, Jefferson Co. Colo., Aug. 23, 1990. L. q. dalmatica is an introduced Mediterranean plant, now enormously abundant in the Front Range foothills on open E- and S-facing slopes (and some dry N-facing slopes), and 63 larval clusters were found on it; normally E. c./a. capella is rare, but in 1989 it was extremely common in an area centered on Tucker Gulch (it was fairly common but less so nearby at Mt. Zion, Guy Hill, and Van Bibber Creek, three sites at the periphery of the population explosion), and rather common at the Tucker Gulch epicenter also in 1990, evidently because the Tucker Gulch population developed (evolved?) the ability to eat the plant, then the abundance of the plant led to an infestation; the native hostplants (Penstemon virgatus asagravi and P. glaber=alpinus) are uncommon in the foothills, which explains the usual rarity of capella. Castilleja miniata and C. integra are not hostplants, evidently because females do not like their biochemicals. Other Scrophulariaceae are not hostplants probably because of physical deficiencies as well as for probable biochemical reasons: Linaria vulgaris leaves are too narrow and the plants too small to support a larval cluster, Verbascum is very hairy, Penstemon virens is very abundant but has very tough dry leaves, Penstemon secundiflorus has very glaucous leaves; no butterfly eats the latter three as far as known, although there is a record of E. c./a. capella on P. secundiflorus in Larimer Co. Colo. (which must be a rare occurrence if the plant was correctly identified) and Precis coenia sometimes eats L. vulgaris). Half-grown larvae hibernate. Egg pale-green when laid, becoming pale yellow; some eggs are pale-red, evidently due to virus or heat death. FIRST-STAGE LARVA orangish-yellow, after feeding greenish on top of T1 or T2 to A3, later becoming light brown; head & collar black. MATURE LARVA (Tinytown) white with black spines, some scoli (middorsal, supraspiracular) have orange bases as in ssp. "brucei", larva resembles brucei but body ground color white due to expansion of the white bands of "brucei" nearly all over the body; head black.

Euphydryas editha beani (Skin.) (= hutchinsi McD. = gunnisonensis Brown = alebarki F.). Adults associated with Castilleja flava (a few Penstemon strictus also present at locality), SW Hot Sulfur Springs, Grand Co. Colo., June 30, 1989

Poladyras minuta minuta Edw. 10 eggs in cluster on leaf underside of Penstemon jamesii (det. J. Scott, and flowering plants found here on May 26, 1985 det. by W), E of Abbot, 5200', Colfax Co. New Mex., Sept. 11, 1978. 25 eggs on underside of P. jamesii leaf, Taylor Springs, 5000', Colfax Co. New Mex., Sept. 11, 1978. Many eggs and larvae on underside of P. jamesii leaf, Eagletail Mtn., Colfax Co. New Mex., Sept. 13-14, 1980. Cluster of 32 yellow

eggs on underside of P. jamesii (W) leaf, Eagletail Mtn., Colfax Co. New Mex., May 27, 1985. Egg cluster on underside of leaf, and two plants with first-stage larval feeding damage, all on P. jamesii (W), 18 mi. WNW Tucumcari, San Miguel Co. New Mex., May 13, 1985. Adults assoc. P. jamesii (W), Canadian R. W of Roy, Mora Co. New Mex., May 12, 1985. Five egg clusters on underside of Penstemon albidus (blue-flowered variety)(W) leaves, Caprock S of San Jon, Quay Co. New Mex., May 13-14, 1985 (plants of Penstemon secundiflorus--not a host--at this site showed no evidence of P. minuta feeding or eggs). Three egg clusters (24, 29, and 33 eggs) and other 1st-2nd-stage larvae found on underside of Penstemon cobaea (det. J. Scott and Roy O. Kendall) leaves, some larvae diapaused even this early in year, Seymour, Baylor Co. Texas, May 1, 1972. Scott (1974b) reared adults from this site, released reared females in front of Colo. arachne males to obtain matings, reared the F1 offspring, released F1 females in front of wild Colo. arachne males to obtain matings, and reared the backcross offspring: in the lab, minuta larvae ate leaves of P. cobaea, Penstemon confertus (W), P. confertus procerus (W), young P. secundiflorus (W), Penstemon whippleanus (W), Penstemon strictus (W); F1 hybrid (ssp. minuta female X ssp. arachne male) and backcross (F1 female X arachne male) larvae also ate young P. secundiflorus and other Penstemon. Half-grown larvae hibernate. Early stages (see also Table 2): MATURE LARVA entirely orange (in Baylor Co. Tex. and Colfax Co. N.M.; versus white in arachne) including the subdorsal scoli (which are orange with black tips in ssp. minuta and arachne), except all other scoli black, a narrow middorsal black line on T2-3, middorsal black scoli have some black around base, subdorsal scoli bases have black tapering forward and rearward to form an interrupted black band; head orange, with a brown patch around eyes, and a thick brown curled mark resting on top of frontoclypeus (no brown spot beside this mark or a very weak one, whereas arachne usually has a brown spot), lower part of frontoclypeus brown. PUPA white with many black bars & spots & orange dorsal cones: front of head has a black ventral spot on each side, and often a brown anteroventral transverse rim, eye cream, orbit and just below it black, a black oblique rectangle angles from bottom-middle of orbit to base of proboscis, posterior end of frontoclypeus narrowly black, proboscis mostly blackish except for a cream patch near base of middle leg, which patch is just ventral to the rear half of the white base of middle leg (middle leg then has a blackish bar across it and distal part is cream), hindleg blackish except dark-cream at extreme base and a cream bar across leg just beyond point where middle leg ends, antenna has alternating black and orangish bars (except shaft has an orangish streak down it medially, and the bulbous antenna base has a creamy sliver medially and a creamy bar distally), anterior edge of T1 has a small subdorsal oval, T1 spiracle orangish-black, anterior edge of T2 has a triangular spot (this spot in arachne is usually widened medially to often join its fellow on the other side, but occasionally is triangular also) pointing rearward near midventral line, this triangular spot often narrowly-connected (seldom connected in arachne) to a curled black mark (which starts above anterior wing base, extends upward just in front of a subdorsal orange cone, then rearward [and angles slightly medially; where it comes close to its fellow on the other side there is a slightly-orangish spot], then posterolaterally to widen where it touches T3), touching the T2 curled mark is a black mark on T3 just below a subdorsal orange cone and a small black spot just above cone, the anterior rim of A1 is blackish between a slight middorsal cone and a slight subdorsal cone (both cones very rudimentary and black with a slight amount of orangish behind), A2-8 have a middorsal anterior black semicircular crescent (only the front half of the circular spot present) that encloses an orange middorsal cone, A2-8 also have a subdorsal black crescent (similar in shape & orientation but wider from side-to-side than the middorsal crescent) enclosing an orange subdorsal cone (this cone more posterior than middorsal cone [in middle of segment]), (the subdorsal black crescents are longest from side to side on A2-6, shorter A7, shortest A8)(the middorsal and subdorsal crescents are often fused anteriorly on A2-3 in minuta, seldom in arachne), on A2 the subdorsal crescent extends anterolaterally to level of spiracle, on A3-4 the subdorsal crescent also extends anterolaterally to level of spiracle and ends just anteroventral to a supralateral orange cone, the posterolateral corner of A2 & A3 have a black triangle that anteriorly includes spiracle, A1-9 each have a narrow black posterior rim (continuous from middorsal to supraspiracular)(front-to-back thickness greatest on A8) just in front of the black middorsal/subdorsal crescents of the segment behind (this posterior black rim is present on all minuta [though weak on a few] but absent on A4-6 of most arachne [except one has it on A6, and one has a streak representing lateral part of black rim on A4-6]), A9 has no cones but has an anterior subdorsal black patch, A10 has a subdorsal band extending into the dark-brown cremaster, A4 has

a black oval whose side touches posteriorventral half of spiracle, A5-7 have a black oblique streak containing spiracle (extending from just above & behind spiracle anteroventrally then curving posteriorly a bit) that has some orangish flush behind it, A8 has a little blackish in front of and below spiracle and some orangish behind, A9 has a black lateral spot that extends back along cremaster, A5-9 have anterior (but in middle of A9) black rectangles just lateral to the midventral line and A10 has a similarly-positioned black band extending onto cremaster, A4-7 have midventral black patches (on rear of A4, mostly on front and rear of A5-6, on front of A7), orange-brown is between these two rows of ventral spots of A5-10, A5-6 are narrow ventrally, A7 very narrow, A8 constricted to nothing ventrally, A9 has midventral sex-mark and two small orange-tipped black projections (the anterior ends of the two sustensor ridges of cremaster base), the brown cremaster has wide lateral shoulders prior to cremaster tip, wing base has a transverse black dash next to antenna, an transverse orangish-brown dash behind it, a black rectangle extending posteriorly from that, then a short transverse narrow black streak, then several small black streaks beside a transverse black crescent (slightly-concave anteriorly) that touches anterolateral corner of T3 (all these wing base marks have orangish-brown between them), a tiny black spot is below this crescent near antenna, hindwing base has a black spot, hindwing sliver is orangish-brown, a black irregular patch is on anal margin of wing just below A2, wing margin is orangish-brown on tornus, a black rectangular mark on tornus is partly divided by a submarginal orange-brown line that extends to apex where it runs through a transverse apical black patch, 3-4 black postmedian longitudinal streaks (the upper oval) are just above antenna, in middle of wing a black patch extends posteriorly then turns anteroventrally for a short distance, between its turn and the tornal black mark are 1-2 small black spots (often a black dot above the front of a longitudinal black streak), in minuta the tornal mark and mid-wing patch are usually separated by these small spots but occasionally are connected by black, whereas in arachne most individuals have tornal mark and mid-wing patch connected. The taxonomy of P. minuta has been subject to much incompetence in print. In several characters arachne falls between monache and minuta (antenna club color, width of unh red and white bands; minuta is not extinct in the U.S. as the Kerrville types are similar to extant N Tex.-E N.M. populations; both arachne and minuta fly in Colfax Co. New Mex. (the latter 2300 feet lower on the plains) where intermediates may occur (adults are rather similar and the larvae show the greatest difference between these two ssp.; the most extreme examples of minuta (thick black unh marginal line etc.) are in E Mex., which may represent a new ssp.

Poladryas minuta hybrids (of Scott 1974b). MATURE LARVA (F1 ssp. minuta female X ssp. arachne male) intermediate in black bands & orange ground color to arachne & minuta: slightly-whitish orange (closer to minuta in color) a narrow middorsal black band, a partial blackish band is formed of a brown patch in front of supraspiracular scoli and a small amount of brown behind, a narrow blackish line is below subspiracular scoli. PUPA (F1) intermediate, posterior black rim on top of A4-6 very narrow on A5-6, absent on A4, tornal spot connected or not to midwing spot, A2-3 middorsal & subdorsal crescents touching. MATURE LARVA and PUPA (of backcross, F1 female X arachne male) very similar to arachne in appearance.

Poladryas minuta arachne Edw. Oviposition Penstemon virgatus (W), Cripple Creek, Teller Co. Colo., Aug. 1969. 4 larvae on P. virgatus asagravi (W), Green Mtn., Jefferson Co. Colo., Aug. 14, 1978. Adults associated with P. v. asagravi, 1 mi. up N Fork Clear Creek Can., Clear Creek Co. Colo., July 25, 1987. Oviposition 12:25-12:31 35 eggs on underside of leaf of P. v. asagravi 5 cm seedling, Guy Hill, Jefferson Co. Colo. June 8, 1988. Oviposition 11:01 3 eggs (I disturbed her trying to get photo and she flew away, and would have laid many more eggs) in cluster on P. v. asagravi, Guy Hill, Jefferson Co. Colo., June 17, 1988; on June 19 I looked at this same leaf and found shiny spots where "25 eggs had been laid in a cluster, so the female must have returned to this same leaf and laid "22 more eggs, then all eggs were eaten by a predator. Preoviposition 10:33, cluster of 64 eggs found under leaf, all on P. v. asagravi, N fork Clear Creek, Gilpin Co. Colo., July 11, 1991. Egg clusters (26, 27, 52 eggs) found under leaves, a 2nd and a "3rd-stage larvae found on leaf bases halfway up plants, all on P. v. asagravi; N fork Clear Creek, Gilpin Co. Colo., July 29, 1991. Adults associated with common Penstemon albidus which is surely the hostplant on the plains here (a few Penstemon angustifolius occurred but this plant has thick glaucous leaves like P. secundiflorus which P. m. arachne shuns), E Box Elder Creek at Quincy Ave., Arapahoe Co. Colo., June 4-5, 1988. Adults associated with common P. albidus (a few P. secundiflorus present which arachne shuns, no P. angustifolia seen), E Delbert Rd., Smoky Hill

Rd., Arapahoe Co. Colo., May 19, 1992. Enough evidence is now available to be certain that P. v. asagravi is the main hostplant in the foothills of the Front Range. Penstemon glaber is occasionally eaten (there is a published record for P. glaber [as P. alpinus] from Larimer Co., J. & G. Sperry 1932 Bull. So. Calif. Acad. Sci. 31:8), but it is rarer than P. v. asagravi; Penstemon gracilis could be used but is very rare (I have found it only at Corwina Park); P. albidus is no doubt a host on the plains. Penstemon virens is very abundant (by far the commonest Penstemon) but its leaves are very tough (it is restricted to N-facing slopes which may also be undesirable) so it is shunned; Penstemon secundiflorus has thick glaucous leaves and is shunned; "P. barbatus torreyi" was reported as a hostplant in Boulder Co. in the Front Range (J. Emmel, O. Shields, D. Breedlove, J. Res. Lepid. 9:238), but this plant was misidentified because P. barbatus does not occur within 100 miles of Boulder Co. (the closest site is Manitou in El Paso Co., W. Weber pers. comm.), and probably was P. v. asagravi which has similar leaves. Lab larvae ate Penstemon whippleanus (W), young P. v. asagravi (previously identified as P. secundiflorus, which is doubtfully eaten), Penstemon griffinii (W), P. barbatus, and Penstemon pinifolius. Scott (1974b) details ecology, behavior, and movements and studies hybrids between minuta and arachne. Neither P. minuta ssp. has larval nests. Half grown larvae hibernate. Early stages from Colo. (see also Table 2): EGG pale yellow. 1ST-STAGE LARVA yellowish-cream, turning greenish-cream anteriorly after feeding, with dark-brown seta bases, suranal plate, and collar; head black. MATURE LARVA white, with a middorsal wide black line containing black scoli, next a wide white subdorsal band containing (and interrupted by) orange (black-tipped) subdorsal scoli (orange just in front of this scoli, and the narrow piece of white band is replaced by orange just above scoli), a wide black supraspiracular band containing black scoli (except the T2-3 scoli are just below this band in the next white band), a wide white band containing black spiracles and subspiracular black scoli, underside dark-brown (the upper edge of this brown area is sometimes a blackish-brown line), in this brown area are paired small scoli just above level of prolegs (body sometimes orange around these scoli), a ventral band of white mottling contains legs & prolegs, a midventral dark-brown line is on abdomen of at least some larvae, all scoli black except subdorsal ones, legs black, prolegs orange; head orange, with a brown patch around eyes, and a thick brown curled mark resting on top of frontoclypeus, a very weak or fairly distinct brown spot (absent or very weak in ssp. minuta) occurs lateral to the lower part of this mark, lower part of frontoclypeus somewhat brown. PUPA white with many black bars & spots, & dorsal orange bumps (middorsal, subdorsal, supralateral bumps), pupa very similar to minuta (see it for description), except a posterior black rim is absent on top of A4-6 (except one has it on A6, and one has a streak representing lateral part of black rim on A4-6) (versus rim present on all minuta, though weak on a few), the black mark on wing tornus is usually connected to mid-wing patch (versus usually separated in minuta), black wing marks are thicker (at least in offspring of some females), the spot on anterior edge of T2 is usually widened medially to often join its fellow on the other side (spot usually triangular in minuta) and the spot is rarely connected to curled mark (often narrowly connected to curled mark in minuta), the black middorsal and subdorsal crescents on A2-3 are usually separate (versus often fused anteriorly in minuta).

Table 2. Differences between Poladryas minuta minuta & P. m. arachne.

Trait	<u>minuta</u>	<u>arachne</u>
larval (older) ground color	orange	white
larval gena beside brown curled mark	brown spot absent or very weak	brown spot fairly distinct or very weak
pupal black posterior rim of top of A4-6	present (though weak on several)	absent (except present laterally on one, present on A6 on one)
pupal black wing spots	tornal mark usually separated from mid-wing patch by several small spots	tornal mark usually connected to mid-wing patch

pupal black spot on anterior edge of T2	usually triangular, often narrowly connected to curled mark	usually widened medially, rarely connected to curled mark
pupal middorsal & subdorsal black crescents A2-3	often fused together anteriorly	usually separate

Chlosyne theona thekla (Edw.). 15 larvae found on Castilleja lanata bracts reared to adults, Guadalupe Can., Hidalgo Co. New Mex., Aug. 4, 1986; third-stage larvae hibernate.

Chlosyne leanira leanira F. & F. Larva on Castilleja sp., Jerseydale, Mariposa Co. Calif., April 20, 1974. Many larvae on Castilleja foliolosa (H) and Castilleja martinii (H) reared to adults, Monticello Dam, Yolo Co. Calif., March 16-17, 1974. Larvae on Castilleja sp., Del Puerto Can., 22 mi. W. Patterson, Stanislaus Co. Calif., May 22, 1971. Larvae on Castilleja sp., Alum Rock Park, Santa Clara Co. Calif., March 6, 1970. Larvae of all C. leanira ssp. eat the flower bracts. One yearly flight.

Chlosyne leanira alma Strk. Larvae on Castilleja chromosa (H), Brunswick Can., Ormsby Co. Nev., April 21, 1974. Larvae on C. chromosa (H), Red Rock Can., Kern Co. Calif., May 5, 1974. Larvae on C. chromosa (W) reared to adults, W of Uravan, Dolores River, Montrose Co. Colo., April 29-30, 1978. Larva on C. chromosa reared to adult, 1-2 mi. N Mesa Co. line, Dolores River, Mesa Co. Colo., May 1, 1978. One yearly flight.

Chlosyne leanira fulvia Edw. Many larvae on Castilleja integra (W) reared to adults W & SW Pueblo, near Beulah, and E Wetmore, all Pueblo Co. Colo., 1965-1970. Oviposition 13:30, a female resting on ground laid one egg cluster on underside of lowermost leaf of plant base of C. integra, E of Wetmore, Pueblo Co. Colo., July 5, 1970. Larva on C. integra, Smith Creek Cgd., Custer Co. Colo., July 27, 1970. Larva on C. integra reared to adult, Green Mtn., Jefferson Co. Colo., Aug. 12, 1977. Larvae on C. integra, W of Pagosa Jct., Archuleta Co. Colo., Aug. 28, 1977. Larvae on C. integra, 9 mi. E of Hwy. 151 on road to Pagosa Springs, Archuleta Co. Colo., Aug. 28, 1977. 30 eggs on base of stem of C. integra reared, 1 mi. S Cochiti Dam, Sandoval Co. New Mex., Sept. 9, 1977. 5 larvae on C. integra bracts, 18 mi. WNW Tucumcari, San Miguel Co. New Mex., May 13, 1985. Larvae on C. integra bracts, Caprock S of San Jon, Quay Co. New Mex., May 14, 1985. Steven Cary found larvae on C. integra (W), Cooke's Peak, Luna Co. New Mex., May 11-12, 1985. 2 females flew out from under Castilleja lanata, Guadalupe Can., Hidalgo Co. New Mex., Aug. 4, 1986. 17 eggs found on dorsal surface (twisted so facing ground) of 12-mm-long leaflet from base of plant main stem ~1.5 cm above ground, 2 mature larvae found on bracts, female preoviposition 14:20, all on C. sessiliflora (C. sessiliflora is the only host here because C. integra--the usual host in S Colo.--is absent), S Midway, Pueblo Co. Colo., May 6, 1992. ~8 larvae ~8 mm long found on C. sessiliflora (W) (the only Castilleja present) bracts; S Gothenburg, Dawson Co. Neb., June 7, 1990 (and adults associated C. sessiliflora there June 30, 1985, June 17, 1987). Adults associated with C. sessiliflora (no inflorescences seen), SW Medicine Lodge, Barber Co., Kans., Sept. 4, 1986. Adults assoc. C. sessiliflora in W Kans. (Steven Spomer pers. comm.). Females oviposit beneath lower leaves, and stage 1-2 larvae seem to eat the lower leaves, whereas older larvae eat the red bracts where they are very conspicuous; even older larvae may eat mostly leaves in late summer when the plants (esp. C. sessiliflora) seldom flower. Three yearly flights. Half-grown larvae hibernate. Egg greenish-yellow, ~21-22 vertical ribs on top. 1ST-STAGE-LARVA tan-green, collar and head dark-chitin-brown (note: the "1st-stage" larval head drawn in Scott [1973] is really 2nd-stage). SYSTEMATICS. Ssp. pariaensis (Smith & Brock) was named as a ssp. of C. fulvia, but is obviously intermediate between alma and fulvia in adult traits, because it has two characters like alma (hostplant and single generation), is intermediate in the color of wing uppersides, and has two characters like fulvia (unh postbasal pattern and palpi color). In addition, the color pattern of larval body & head (Scott 1986b) of C. leanira (including fulvia) follows clines or step-clines whose midpoints do not support dividing the species in Smith & Brock's arbitrary manner: older larval ground color is orange (Calif. leanira, W Nev. alma), yellow-orange (W-C Colo. alma, S Utah pariaensis), orange-yellow (S and C Colo. fulvia), yellow (Ariz.) indicating the midpoint of the cline in C Colo.; black bands are very wide in Baja Calif. (Ralph Wells pers. comm.), quite wide in S Calif., narrower elsewhere, indicating a midpoint of variation somewhere N of Los Angeles; the black subdorsal band contains many white dots in

ssp. leanira and wrighti but not indicata indicating a midpoint of variation somewhere in the W edge of the Mojave Desert; the older larval head is black in wrighti and leanira and alma, reddish-brown (C Colo. fulvia), orange (Ariz., S Utah), indicating a cline midpoint in C Colo. Smith & Brock (1988) must have read about the larval traits cited by Scott (1986) because they cited that book, but chose to ignore larval traits. Obviously fulvia is the same species as leanira when all characters are considered. Competent evolutionary biologists interpret clines and intermediate populations as keys to understanding evolution and speciation and applying the biological species concept; splitters have the amazing ability to divide even a perfect cline into two species by arbitrarily assigning midpoint populations to one endpoint or the other. Thus Smith & Brock (1988) picked the S Utah-W Colo. area between alma and fulvia as their dividing point, based on selected adult traits, ignoring four larval traits whose dividing points occur in Calif. or C Colo. (and of course the most obvious adult trait of black vs. red wing color has its dividing point at the W end of the Mojave Desert in Calif.). They also failed to note that their ssp. coronado often tends toward another taxon cyneas in wing color and that these two have numerous similarities in larval traits and that a lowland Chiricahua Mts. population has individuals that could be interpreted as (and have been in print) intergrades, so that fulvia and cyneas may not be 100% distinct species either.

Chlosyne gorgone (Hubn.). Many larvae on Helianthus pumilus, Chimney Gulch, Jefferson Co. Colo., July 10 and 17, 1978. Larvae common on H. pumilus, Iron Dollar Gulch, Fremont Co. Colo., July 13, 1971, and at Fleming Mtn., Fremont Co. Colo., 1969-70, and at Red Rocks, Jefferson Co. Colo., July 10, 1972. Several hundred larvae beneath leaves of H. pumilus, Golden Gate Can., Jefferson Co. Colo., July 18, 1984. 6 H. pumilus plants had half grown gregarious larvae, Red Rocks, Jefferson Co. Colo., July 4, 1988. 4 H. pumilus plants had clusters of 3rd stage larvae, Mt. Zion, Jefferson Co. Colo., July 6, 1988. 2 H. pumilus plants had clusters of 3rd stage larvae, Mt. Zion, Jefferson Co. Colo., July 11, 1988. ~10 half-grown larvae found on H. pumilus, Chimney Gulch, Jefferson Co. Colo., July 16, 1989. ~4 H. pumilus plants had larval feeding damage, Mt. Zion, Jefferson Co. Colo., July 29, 1989. ~3 H. pumilus had larval feeding damage, Crawford Hill, Jefferson Co. Colo., Aug. 1, 1989. Preoviposition 11:24 H. pumilus; Apex Gulch, Jefferson Co. Colo., June 4, 1990. ~10 H. pumilus plants had half-grown larvae; Green Mtn., Jefferson Co. Colo., July 12, 1990. Larvae on H. pumilus; Mt. Zion, Jefferson Co. Colo., July 14, 1990. Larvae found on 2 H. pumilus plants; Falcon County Park, Jefferson Co. Colo., July 18, 1990. Larvae (forms unicolor & bicolor) found on H. pumilus; Falcon County Park, Jefferson Co. Colo., July 30, 1990. Preoviposition 12:30-12:45 then oviposition 12:45-14:15 ~140 eggs (she kept laying as I carried branch back to car) under H. pumilus leaf, Lookout Mtn., Jefferson Co. Colo., June 6, 1991. Hundreds of larvae on H. pumilus and Helianthus petiolaris (larvae of forms nigra and bicolor on both plants, one form rufa larva on H. pumilus), Green Mtn., Jefferson Co. Colo., July 9, 1980. Larvae on H. petiolaris, Smith Creek Cgd., Custer Co. Colo., July 1971. Adults associated with H. petiolaris, E of Renville County Park, Renville Co. Minn., July 12, 1986. Half-grown larva on H. petiolaris leaf; cluster of ~136 eggs found under H. petiolaris leaf; 1 mature larva found on Iva (Cyclachaena) xanthifolia leaf; cluster of ~210 eggs under I. xanthifolia leaf; no eggs found on many Verbesina encelioides; Barr Lake, Adams Co. Colo., Aug. 30, 1991. Many larvae on Helianthus annuus L., few larvae on Iva xanthifolia, few larvae on Ambrosia trifida, Vineland, Pueblo Co. Colo., Aug. 4, 1983. About 50 larvae on A. trifida (W), Green Mtn., Jefferson Co. Colo., Aug. 10, 1978. ~100 3rd stage larvae feeding on top of I. xanthifolia leaf (sky hazy due to forest fire smoke so leaf top not too hot for larvae), Barr Lake, Adams Co. Colo., Sept. 6, 1988. 2 half-grown larvae of form bicolor found on I. xanthifolia leaf, Barr Lake, Adams Co. Colo., Sept. 5, 1989. Oviposition 10:59-11:19 ~138 eggs (I scared her taking photo so she may have laid more eggs) in a two-layered mass (top layer only 25% of eggs) on underside of I. xanthifolia leaf, Senac Creek, Arapahoe Co. Colo., Sept. 9, 1988. Larva (form rufa) on top of leaf (eating a strip into it) of Xanthium pennsylvanicum var. strumarium, Barr Lake, Adams Co. Colo., Sept. 8, 1987. The native bushy H. pumilus is almost the only host in the foothills, but on the plains the other hosts, mostly weeds, are eaten. Half grown larvae hibernate, and breaking

diapause in the lab is very difficult. EGG greenish-yellowish-cream. 1ST-STAGE LARVA orangish-cream, setae dark-brown, collar gray; head black.

Chlosyne nycteis drusus (Edw.). Many larvae on underside of leaves of Rudbeckia laciniata var. ampla (W) (now often treated as a species, R. ampla), Sapello Can., San Miguel Co. New Mex., Aug. 23, 1978. Larvae and feeding damage

54 on R. l. var. ampla, Tecolote Creek, San Miguel Co. New Mex., Sept. 10, 1978. Larvae on R. l. var. ampla, Raton Mesa, Colfax Co. New Mex., Aug. 24, 1979. Larvae on R. l. var. ampla, Rio Grande del Rancho, Taos Co. New Mex., Aug. 27, 1978. Larvae on R. l. var. ampla, near Mora, Mora Co. New Mex., Aug. 25, 1978. Several larvae on underside of leaves and feeding damage noted on R. l. var. ampla, Spring Creek Picnic Ground, Huerfano Co. Colo., Aug. 21, 1980. 15 egg clusters on underside of leaves of R. l. var. ampla, Devils Gulch near Idledale, Jefferson Co. Colo., July 11, 1980. Oviposition 9:31 about 100 eggs on underside of leaf of R. l. var. ampla, Devils Gulch, July 7, 1981. 17 clusters of larvae on underside of leaves of R. l. var. ampla, Tinytown, Jefferson Co. Colo., July 26, 29, 30, 1978. Oviposition cluster of 153 eggs on underside of leaf, and 2 egg clusters of 134 and 95 eggs found on other leaves, all on R. l. var. ampla, Tinytown, Jefferson Co. Colo., July 20, 1984. 20 egg clusters found on R. l. var. ampla (G), Golden Gate Can. State Park, Gilpin Co. Colo., July 4, 1977. Larvae on R. l. var. ampla, Golden Gate Can., Jefferson Co. Colo., Aug. 22, 1983. Many eggs on R. l. var. ampla, N fork Clear Creek, Gilpin Co. Colo., July 7, 1977. 28 egg clusters on R. l. var. ampla, NW Nederland, Boulder Co. Colo., July 16, 1977, July 24, 1977. 1st stage larvae on underside of leaf of R. l. var. ampla, Shingle Creek, Jefferson Co. Colo., July 23, 1984. 1st-2nd-stage larvae on underside of leaf of R. l. var. ampla on six plants, O'Fallon Park, Jefferson Co. Colo., Aug. 12, 13, 16, 1984. 5 clusters of 2nd stage larvae on underside of R. l. var. ampla leaves, O'Fallon Park, Aug. 12, 1985. 21 clusters of larvae found on underside of leaves of R. l. var. ampla, Corwina Park, Jefferson Co. Colo., Aug. 17-27, 1984. Cluster of 2nd stage larvae on underside of R. l. var. ampla leaf, Kerr Gulch, Jefferson Co. Colo., Aug. 12, 1985. Many 3rd stage larvae diapausing in dead curled leaf tip of R. l. var. ampla, NW Big Turkey Cgd., Douglas Co. Colo., Aug. 26, 1985. Several 3rd-stage larvae found on underside of leaves, and dead curled leaves showing larval feeding damage, all on R. l. var. ampla (W), NE Hannagan Meadow, Greenlee Co., Ariz., Aug. 9, 1986. 5 clusters of 1st- and 2nd-stage larvae found on R. l. var. ampla, O'Fallon Park, Jefferson Co. Colo., Aug. 15, 1986. Oviposition 12:33-13:05 (of two clusters of 67 eggs and 43 eggs side-by-side) on underside of R. l. var. ampla leaf, N Fork Clear Creek Can., Gilpin Co. Colo., July 25, 1987. Cluster of 1st-stage larvae on underside of R. l. var. ampla leaf, O'Fallon Park, Jefferson Co. Colo., July 29, 1987. 6 clusters of larvae found on underside of R. l. var. ampla leaves, ENE Guy Hill, Jefferson Co. Colo., July 30, 1987. Larvae found on underside of R. l. var. ampla leaf, NW Guy Hill, Jefferson Co. Colo., July 30, 1987. 6 mature larvae found, 3 on top of R. l. ampla leaves 10-15 cm above ground (2 of them eating leaf margin near midday), and 3 on litter below heavily-eaten ampla leaves, N fork Clear Creek, Gilpin Co. Colo., June 14, 1989. Newly-emerged male found next to R. l. ampla, SW Hot Sulfur Springs, Grand Co. Colo., June 24, 1989. Egg cluster of ~80 eggs found on R. l. var. ampla leaf underside, Rabbit Ears Pass, Routt Co., Colo., July 7, 1989. 1 cluster of 1st-stage larvae and 2 clusters of 2nd-stage larvae found on R. l. var. ampla leaf undersides, Tinytown, Jefferson Co. Colo., July 25, 1989. 2 clusters of 2nd- and ~3rd-stage larvae found on R. l. var. ampla leaf undersides, Tinytown, Jefferson Co. Colo., Aug. 21, 1989. 5 R. l. var. ampla plants seen with 2nd-3rd-stage larvae, O'Fallon Park, Jefferson Co. Colo., Aug. 26, 1989. 2 R. l. var. ampla plants had larval feeding damage and 1 larva ~2nd stage found on one of them, Van Bibber Creek, Jefferson Co. Colo., Aug. 28, 1989. Preoviposition R. l. var. ampla; Tinytown, Jefferson Co. Colo., June 26, 1990. Egg cluster of 177 eggs and another cluster equally large found on R. l. var. ampla leaf underside; Tinytown, Jefferson Co. Colo., July 2, 1990. 3 clusters of larvae found on R. l. var. ampla leaf undersides; Golden Gate Can. State Park, Gilpin Co. Colo., July 25, 1990. 14 older larvae found on top of R. l. ampla leaves which were heavily chewed, 1 prepupa found hanging from 20-cm-tall dead stalk ~4 m from R. l. ampla, Tinytown, Jefferson Co. Colo., June 5, 1991. Cluster of ~50 1st-stage larvae found on R. l. ampla, Tinytown, Jefferson Co. Colo., July 31, 1991. Mature larva found on chewed R. l. ampla leaf top, Tinytown, Jefferson Co. Colo., June 11, 1992. Mature larva found on R. l. ampla chewed leaf top, Tinytown, Jefferson Co. Colo., June 2, 1992. R. l. var. ampla is obviously the only Rocky Mts. host, whereas several hosts in addition to R. laciniata var. laciniata are eaten in E U.S. Half-grown larvae hibernate, and breaking diapause in the lab is very difficult. Early stages (Gilpin & Jefferson Cos.): EGGS greenish-yellowish-cream. FIRST-STAGE LARVA yellowish-cream, a weak tan middorsal line; collar and head black. 2ND-STAGE LARVA cream (lateral area slightly orangish-cream), a middorsal brown band, a brown wide subdorsal band clasping subdorsal BD2 scoli from below; head black. 3RD-STAGE LARVA blackish-brown with numerous tiny cream dots, tan between segments, 2 middorsal cream lines on A1-9, a cream band above spiracles T2-A9, a cream band

below spiracles along BL scoli T2-AS, a broad tan subventral band on abdomen includes prolegs (edged by a dark brown midventral band except between segments), scoli chitin-brown, the dark-brown lateroventral patch on each abdomen segment is constricted anteriorly & posteriorly to create an interrupted tan band below BL scoli (dark-brown in middle of segments) and just above 3 sublateral tan SV seta bases; head black, dark-brown on lower front. MATURE LARVA blackish-brown, with many cream dots each with one seta, two middorsal rows of cream dots, a cream suprspiracular line just above spiracles & at base of BSD scoli (the line orange just below each BSD scoli, and on one larva partly orange from there to anterior segment), an interrupted cream line runs between BL scoli, base of BL scoli orange-ochre all around except anteriorly, the area between cream suprspiracular line and cream BL line has more cream dots than usual, underside slightly-reddish brown with cream dots, proleg light-brown with dark-brown shield, T1 has cream in front of black collar (the cream extending laterally to meet the cream line along BL scoli), ventral neck gland large, scoli black with black needles (except BL scoli have brown basal 1/3, and BSV scoli have brown bases and blackish-brown tips); head black, epicranial groove cream. PUPA dirty-cream (one is yellowish-cream, one pupa blackish-brown with cream mottling) with blackish-brown spots; many cones present on abdomen which are orange behind an anterior blackish crescent (middorsal cones [A3-7 large, A2 small, A1 a black dot without a cone], subdorsal [A3-7 large, A2 small, A1 a black dot without a cone], suprspiracular [A3-4, a black spot on A5-8 without a cone]), but the subdorsal cream cone on T2-3 has a black crescent in front edged posteriorly by an orange crescent [both on front of cone]; many black spots (top of head has a sinuous line of black spots below two black apostrophes, a black spot is just anterior to eye, subdorsal brownish spots on T1 and front of T2, blackish spot near lateral edge of T1, a blackish spot on A4-8 below spiracles, a subventral blackish spot on A4-7, two midventral rows of black dots on A4-7, a blackish spot is ~2/3 out on each leg), end of proboscis and end of middle leg blackish, wing has black marks (black patch on base, large black patch on posterior base, black spot at end of discal cell, ~8 postmedian black streaks, black marginal black streaks at ends of veins, 2 black areas near margin), a blackish crescent beside anal groove, cremaster dark-brown; the blackish-brown pupa (adult reared) is blackish-brown except for cream on anal area of wing, a cream patch on middle of outer margin of wing, and mottled-brown-and cream top of thorax and abdomen.

Chlosyne palla calydon (Holl.). Cluster of young larvae on underside of leaf of Erigeron speciosus var. macranthus (W), NW Nederland, Boulder Co. Colo., July 24, 1977. Three egg clusters on underside of E. s. var. macranthus leaves, Ralston Butte, Jefferson Co. Colo., June 20, 1980, a hillside that had burned several years earlier where both hosts and adults were common. Preoviposition 13:30 E. s. var. macranthus; Tinytown, Jefferson Co. Colo., June 25, 1990. Half-grown larvae hibernate. HALF-GROWN LARVA (Ralston Butte) black with tiny pale dots & many black spines, an ochre band beside a middorsal black line, an ochre band above lateral spines and another ochre band below lateral spines; head black.

Chlosyne whitneyi damoetas Skin. Oviposition egg cluster on underside of leaf of Erigeron leiomeris (G), Hermit Pass, Custer Co. Colo., Aug. 1, 1971. Two egg clusters found on underside of rock beside E. leiomeris and 40 diapausing larvae and 1 pupa reared to adult found near E. leiomeris, Loveland Pass, Summit Co. Colo., Aug. 9, 1978. Four larvae on underside of E. leiomeris (W) leaf, Loveland Pass, July 25, 1978. 11 larvae & 1 pupa found on underside of rocks near E. leiomeris, Loveland Pass, July 15, 1980. Larva found near E. leiomeris, Loveland Pass, July 23, 1981. A female from Loveland Pass July 20, 1977 laid eggs in the lab, and larvae ate E. leiomeris. Adults associated with E. leiomeris, Schafer Gulch Road, Hinsdale Co. Colo., July 21, 1980, and at Uncompahgre Peak, Hinsdale Co. Colo., July 18, 1980, and at Mt. Massive, Lake Co. Colo., Aug. 1, 1982. Half-grown larvae diapause, and there are many (in years of abundance at least, since later years proved that locating larvae is not as easy as I thought) diapausing larvae under rocks near the host even in midsummer when adults and eggs are common, indicating that many larvae take several years to mature. Some larvae probably take 1, 2, even 3 or more years to mature, and thus the life cycle should be described as multiannual (usually biennial or longer). Much of the population at any given time seems to be made up of diapausing larvae, although in some years larvae are very hard to find in midsummer, and thus the population is less susceptible to extinction, because an entire years' crop of adults can be wiped out and the population will come back the next year because some of the diapausing larvae will find hostplants and mature. Breaking diapause in the lab is very difficult even with constant light. Larva & pupa (& photo of pupa) from Colo. described by Scott (1986b).

Phyciodes mylitta (Edw.). 115 eggs in cluster found on underside of leaf of Cirsium vulgare (M), reared to adults in lab on Silybum marianum, Copper, Siskiyou Co. Calif., May 19, 1974. Early stages (from eggs laid by female from Thompson Can., Yolo Co. Calif.): MATURE LARVA blackish-brown with tiny cream dots, a blackish middorsal line, a tan line beside it, a blackish-brown line along top of BD2, a tan line running through BD2 scoli, a wide blackish-brown band from bottom of BD2 scoli to just below BSD scoli, light-brown from just above spiracles to underside (a very faint tan line through top edge of BL scoli and a weak light-brown band just below BL scoli, lateral band slightly orange), scoli dark-brown except BL and BSV scoli orangish-ochre; head black with a subdorsal cream stripe (rarely a cream spot at its anterior end), and rarely a small cream crescent above eyes. PUPA mottled brown, varying to ashy-gray, many cream-topped bumps (with an anterior brown crescent clasping front of bump) on T2-3-abdomen, a crest from tornus over A4 (front slope of crest brown, rear cream), weaker similar crests on A5-7 and T2, a sublateral brown abdomen band, wing has postmedian (always ~5-6 anterior dots in Phyciodes) and marginal cream dots, the usual cream-brown areas on wing.

Phyciodes orseis orseis Edw. Larvae from Siskiyou Co. Calif. (sent by Kenneth Hansen) ate tender flesh on top of bract bases (the part eaten by humans) of grocery-store artichoke Cynara scolymus in lab, though in nature the hostplant is probably Cirsium growing on slopes. Half-grown (stage 3) ssp. orseis larvae hibernate; diapause is difficult to break in the lab even with constant light. MATURE LARVA black with tiny cream dots (overall appearance dark-brown), a middorsal black line edged by a gray (orange at BD1 scoli bases from T3-A9) band (narrow on T1-2), an orangish-cream dash in front of BD2 subdorsal abdomen scoli, these subdorsal scoli have narrow orange-brown bases, a cream line above spiracles (line orange [because of tiny orange spots] in middle of segment at ventral base of supraspiracular BSD scoli), a cream sublateral line touches ventral base of sublateral BL scoli, these BL scoli have orange bases, underside dark-brown; head black (the following dark-brown areas are visible on shed head capsules, but the living heads appear solid black: some larvae have a dark-brown subdorsal stripe with a dark-brown satellite dot just below it, a tiny dark-brown spot on upper end of frontoclypeus, a dark-brown patch on side of frontoclypeus, and a dark-brown tiny spot above eyes). PUPA mottled light-brown or mottled brown (brown with tiny orange-brown marks esp. on upperside, underside slightly-darker-brown), T1 has a cream subdorsal spot, T3 has a brown subdorsal spot with orange-brown behind and medial to it, wing has a brown band from mid-costa to tornus, inner margin of wing brown, a paler area above inner margin of wing, a subapical brown wing spot, wing has tiny pale marginal and ~8 tiny postmedian pale dots, a paler (ochre-brown on front slope, paler tan on rear) crest runs from wing margin above tornus to over the top of A4, and similarly-colored weaker crests are on A5-7 and subdorsally on T2, a weak subdorsal brown abdomen band, a sublateral line of narrow blackish-brown dashes below spiracles on A4-7, a few short blackish-brown subventral and midventral abdomen dashes, rows of small bumps on T2-3-abdomen (these middorsal and subdorsal bumps represent rudiments of larval scoli and are orangish with brown tips); pupal stage 9 days in lab.

Phyciodes orseis herlani Bauer. A female from Glenbrook, El Dorado Co. Calif., June 16, 1972, laid an egg cluster in lab on Cirsium vulgare; the larvae were reared on Cirsium arvense (not on C. vulgare; Scott 1974e reports the life history, Scott 1986b compares larva with ssp. orseis; a line edging heart-line and a wide lateral band are ochre-brown in ssp. herlani, orange in ssp. orseis).

Phyciodes pallida (Edw.). Cluster of 114 yellow eggs on underside of a 15-cm long leaf of fairly young plant of Cirsium ochrocentrum (W), Red Rocks, Jefferson Co. Colo., June 15, 1987. 3rd-stage larva found on top of C. ochrocentrum leaf ~15 cm long of small plant without aerial stem, upperside of leaf tissue eaten in patches 5 mm wide, larva ate Cirsium incanum in lab for several weeks but then diapaused 3rd-stage, S Indian Peak, Jefferson Co. Colo., Sept. 5, 1991. Larvae reared in lab (Scott 1976) on Cirsium arvense and Cirsium vulgare from eggs laid by a female from Red Rocks, Jefferson Co. Colo., June 29, 1973. 3RD-STAGE LARVA black, a middorsal black band contains BD1 scoli, a broad cream band contains BD2 scoli (these scoli have orange bases except ventrally, and the orange bases touch BD1 scoli dorsally), black dashes run between BD2 scoli in the cream band, next a broad black band contains BSD scoli, a cream line is below it, the lateral BL scoli have orange bases except dorsally and are in a broad black band (except cream is in front of BL scoli, and a diagonal cream line is below BL scoli and rises posteriorly), underside brown, scoli black; head black with a cream anteroposterior dash on top of each side of head; interestingly, the 3rd-stage resembles Phyciodes orseis mature larva (whereas

the mature larva is much paler), so that P. pallida perhaps is the closest relative of P. orseis (and orseis and pallida are allopatric so could even be ssp.). MATURE LARVA ochre, a middorsal blackish-brown line, a brown streak anteroposterad of BD2 scoli; a broad blackish-brown band running from below BD2 scoli to lower edge of BSD scoli, spiracles black, an interrupted brown line running along level of lower edge of spiracles, underside (from just below BL scoli) light brown, scoli brown except BL scoli ochre; head black, a cream subdorsal band, a cream crescent above eyes. PUPA mottled light-brown, a weak middorsal abdomen band of brown spots, a subdorsal abdomen band of brown spots edged beneath by cream, a sublateral brown abdomen band edged above by a cream line, tiny subventral & midventral brown abdomen dots, the usual crest over A4 (brown on front slope, cream on rear) from wing to top and similar weak crests on A5-7 and T2, the usual tiny bumps on T2-3-abdomen.

Phyciodes tharos/morpheus morpheus (Fabr.). Six egg clusters and ten clusters of young larvae on underside of leaves of Aster laevis var. geyeri (W), Tucker Gulch, Jefferson Co. Colo., July 8 to Aug. 7, 1978, Aug. 5, 1983, and July 18, 1984. Larvae on A. l. var. geyeri (W), Tinytown, Jefferson Co. Colo., July 30, 1978. Cluster of 39 eggs on underside of A. l. var. geyeri leaf, Coal Creek Can., Jefferson Co. Colo., July 7, 1985. 7 clusters of 1st-2nd-stage larvae found under A. l. var. geyeri leaves of plants about to flower, Tucker Gulch, Jefferson Co. Colo., July 27, 1989. 1 cluster of 1st-stage larvae found on A. l. var. geyeri leaf underside, Tucker Gulch, Jefferson Co. Colo., July 31, 1989. 2 clusters of 2nd-stage larvae found on A. l. var. geyeri leaf undersides, Tucker Gulch, Jefferson Co. Colo., Aug. 1, 1989. Cluster of 4 2nd-stage larvae found on A. l. var. geyeri leaf underside, Stove Mtn., El Paso Co. Colo., Aug. 19, 1989. Ssp. morpheus (= selenis [Kirby] = pascoensis Wright) has recently been treated as a distinct species, and is reproductively isolated from ssp. tharos in the Appalachians, and apparently in S Minn. and W Neb., probably even in N Colo. in Larimer Co., but in central Colorado I reared many adults from Golden Gate Can. and released females in front of P. tharos/morpheus tharos males at a plains site; courtship occurred readily and hundreds of F1 hybrids were reared (Scott 1986c). This suggests that the two are one species. The two ssp. are allopatric in Colo. except the foothills W of Fort Collins, Larimer Co. (Paul Opler), tharos occupying the plains and morpheus the mountains; they best fit the concept of subspecies in C Colo., but are evidently more distinct than the usual subspecies because they are sympatric northward (and in Neb., Minn., etc.); they are not reproductively isolated in Colo., and remain distinct where they are sympatric evidently because their different flight times rarely allow them to interbreed (and perhaps some reproductive isolation in nature has involved in areas northward where they are sympatric). In 30 years I have caught 2 tharos and ~2 morpheus on Green Mtn., Jefferson Co. Colo., 1 1/2 months apart, but this hardly qualifies as sympatry because populations do not exist there and the latter's hostplant does not even grow there. The species name can be cited as P. tharos/morpheus morpheus. Their antennae are the same color (orange) in Colo., whereas they differ in W.Va.-Va.-Penn. where they behave as separate species. Early stages from C Colo. were described by Scott (1986b). Half-grown larvae hibernate. FIRST-STAGE LARVA cream, with subdorsal yellowish patches, long black setae; head black.

Phyciodes tharos/morpheus tharos (Drury). 2 egg clusters and 2 other larvae found on underside of leaves of 3 Aster (Virgulus) ericoides plants (a cluster of 78 eggs produced 27 male 19 female adults, a cluster of 73 eggs produced 14 male 17 female adults, a cluster of two 1st stage larvae later died), Barr Lake, Adams Co. Colo., Aug. 17, 1985. Egg cluster of 53 eggs found on A. ericoides leaf underside, preoviposition 14:10 on A. ericoides, Barr Lake, Adams Co. Colo., Sept. 25, 1989. Adults associated with A. ericoides, Horsetooth Res., Larimer Co. Colo. May 23, 26, 28, Sept. 14-15, 1990. Adult associated with A. ericoides, N Bear Creek Res., Jefferson Co. Colo., Sept. 24, 1990. Adults associated with A. ericoides throughout the plains in Weld, Larimer, Adams, Jefferson, Arapahoe, Elbert, Pueblo and Crowley Cos. Colo. Oviposition 12:20, from 11:30-12:20 she landed on a group of ~5 small non-flowering Aster hesperius Gray within 70 cm on canal bank and mostly rested in shade, sometimes crawling over the leaves or fluttering a short distance to another A. hesperius, at 12:20 she landed on a seedling A. hesperius in sun that she had landed on once before and bent abdomen under a drooping leaf and laid 10 eggs from 12:20-12:26, larvae reared and 2 females emerged Dec. 19; A. hesperius grows only along creeks and ditches, where larvae could be washed away, so it is a less-common hostplant than A. ericoides which occurs in moist meadows and roadsides and is more common; Barr Lake, Adams Co. Colo., Oct. 11, 1989. The species name can be cited as P. tharos/morpheus tharos because tharos & morpheus have not evolved to

be completely distinct species. Early stages from C. Colo. were described by Scott (1986b), and a color photo of larva and pupa is in R. Pyle (1981, Audubon Soc. Field Guide to N. Amer. Butterflies, A. Knopf, N.Y., photo 17 misidentified as P. mylitta). Half-grown larvae hibernate. EGG pale green.

Phyciodes tharos/morpheus riocolorado NEW SUBSPECIES. The name is from the Colorado River. Adults of riocolorado are characterized by having the same pattern of dark lines as typical P. tharos/morpheus tharos, but the black borders are narrower, and the overall upperside color is more ochre-orange (less reddish-orange) than other tharos populations (adults vary little in upperside color); antenna clubs are white-and-black. Paratype female shown in color by Scott (1986b, plate 27 228a). This seems to be the only valid ssp. of tharos, as distincta Bauer (type locality Calexico, Imperial Co., Calif.) is a synonym of tharos (unless distincta is used for the southern populations with white-and-black antenna clubs, tharos for northern populations with orange-and-black antenna clubs), and even tharos from central Mexico do not differ appreciably from SE U.S. tharos. The subspecies is not enormously different from ssp. tharos, but the differences between closely-related species of Phyciodes are not large either. (For those nomenclatural purists who might complain about application of details of ICZN Code articles regarding my use of a / and four names, I now state that the citation as far as ICZN Code is concerned is P. tharos riocolorado, and I state that riocolorado belongs in the species tharos, regardless of whether morpheus belongs in tharos.) Types: wetland at Moab, Grand Co., Utah, Sept. 5, 1978, 1 male holotype and 1 female allotype in Mus. Nat. Hist. Los Angeles County, 3 male 4 female paratypes in my coll.--at least part of this wetland is now a park although the spot where I found these adults may be outside park boundary; Austin, Delta Co. Colo., July 19, 1988, 2 male 1 female paratypes in my coll. Other specimens from Delta Co. Colo. are in the Univ. Colorado Museum. Range: the bottom of hot valleys in the Colorado River drainage at least in Utah from Moab upstream to Colorado River tributaries in the Gunnison River system in Delta Co. Colo. Adults associated with Centaurea (Acroptilon) repens (which is probably not a hostplant), NE Austin, Delta Co. Colo., July 19, 1988.

Phyciodes batesii (Reak). Early stages from Pine Ridge, NW Neb., 1985 (newly-pickled, from Steven Spomer), presented as a comparison to the other Phyciodes: MATURE LARVA brown with tiny cream dots, a dark-brown middorsal line through BD1 scoli (wider around scoli), then a tan band, a dark-brown line through upper part of BD2 scoli, a tan subdorsal line through lower part of BD2 scoli (the second-most-conspicuous band on body), a wide fairly-dark-brown band (brown in intersegmental area) ventrally includes BSD scoli (and has cream dots more frequent above BSD scoli), a wide pale-brown band is formed of a cream-tan irregular line just above spiracles, and a wide tan band with some brown mottling that includes spiracles and BL scoli, and a cream lateral stripe that touches lower part of BL scoli (this is the most conspicuous stripe on body), this stripe edged below by brown, underside light-brown with cream dots, scoli light-brown, T1 collar has a posterior lobe just below midventral plane, T1 brownish-tan, the only bands being a slightly-paler band corresponding to the second-most-conspicuous band noted above, and a pale tan line corresponding to the most-conspicuous band; head black with a subdorsal cream stripe on top of head (its anterior end a cream spot mostly connected to stripe), an irregular tan lateral stripe extends from rear of head forward then above eyes then downward around eyes (and in one of two larvae extends to lower edge of frontoclypeus where it widens), an ochre spot on middle of frontoclypeus. All Phyciodes mature larvae have these same dark bands on body, but in different species the bands may be darker or lighter and some dark bands or pale bands may coalesce; all Phyciodes have black heads with the subdorsal cream stripe. PUPA mottled brown with tiny cream dots, wing has brown streak in discal cell and a brown streak on CuA₂, brown below 1A+2A, pale postmedian and marginal dots on wing, a cream area on wing extending up and over A4 on a crest (the rear slope of crest cream, front slope brown), and similar-colored weaker ridges on A5-7 and T2, a subdorsal pale-brown abdomen band edged beneath by dark-brown (this band is characteristic of the P. tharos-group), a lateroventral pale-brown abdomen band edged below by dark-brown, a weak midventral brown abdomen band, rows of bumps on T2-3 and abdomen (as in all Phyciodes), shape like P. campestris and other Phyciodes, crests over abdomen perhaps smaller than on P. tharos/morpheus. All Phyciodes pupae are mottled brown of some shade with tiny cream dots, all have a crest curving from tornus to the top of A4 and smaller crests on A5-7 and a small bipartite (strongest at start and end) crest on T2, all have these crests colored the same (rear slope of crest cream, front slope brown), all have the same dorsal bumps on T2-3 and dorsal-to-lateral bumps on abdomen (these bumps are homologous to larval scoli), all have ~5 postmedian (on

Phyciodes campestris camillus Edw. Oviposition 99 eggs 11:30, and 15 large larvae found, on Machaeranthera pattersoni (W), Golden Gate Can., Jefferson Co. Colo., Aug. 7, 1978. Oviposition 38 eggs 12:04-12:19 on underside of leaf of seedling (4 cm tall) M. pattersoni, Genesee Mtn., Jefferson Co. Colo., Aug. 22, 1988. 16 eggs found on M. pattersoni leaf underside of seedling plant; Tinytown, Jefferson Co. Colo., Sept. 6, 1990. Adults associated with M. pattersoni growing abundantly near Prairie Dog mounds (M. pattersoni is evidently inedible to prairie dogs), plains Barr Lake, Adams Co. Colo., Oct. 11, 1989, Sept. 8, 1990. Oviposition 100 eggs 13:45-13:50 on underside of leaf of Aster (chilensis) adscendens (W), 7 mi. W Hayden, Routt Co. Colo., Sept. 2, 1978. Oviposition 11:30 88 eggs on A. (c.) adscendens (W), E Portal Moffat Tunnel, Gilpin Co. Colo., July 30, 1977. Adults associated with A. (ch.) adscendens, Bear Creek, Chaffee Co. Colo., Sept. 5, 1990. Oviposition 13:45 of 27 eggs (more would have been laid had I not disturbed her) on underside of leaf of Aster porteri, Green Mtn., Jefferson Co. Colo., June 19, 1985. Female flushed out of A. porteri clump at 12:10, where a cluster of 57 eggs was found on underside of leaf, Red Rocks, Jefferson Co. Colo., Sept. 22, 1987. Preoviposition A. porteri, Lone Rock Cgd., Jefferson Co. Colo., Aug. 27, 1986. Adults associated with A. porteri, Van Bibber Creek, Jefferson Co. Colo., Sept. 23, 1987. Preoviposition 11:05 A. porteri, cluster of 43 eggs found on underside of A. porteri leaf, Falcon County Park, Jefferson Co. Colo., Sept. 18, 1988. Oviposition 45 eggs 11:45-11:55 on underside of 4 mm wide leaf of young plant of Aster (Virgulus) ericoides where young plants were thick, 3 mi. E Vineland, Pueblo Co. Colo., Aug. 28, 1983. Oviposition 11:40 31 eggs on underside of leaf of juvenile A. ericoides plant, Green Mtn., Jefferson Co. Colo., Sept. 4, 1984. 31 eggs in cluster on underside of leaf of young A. ericoides plant, Green Mtn., Sept. 12, 1985. Oviposition, female fluttered about plants 10:45-10:58 then laid 12 eggs 10:58-11:00 under big leaf of seedling A. ericoides var. falcatus (stem hairs spreading), 2 egg clusters of 102 & 150 eggs found 1 m away in middle of A. ericoides var. ericoides (stem hairs appressed), N Bear Creek Res., Jefferson Co. Colo., Sept. 9, 1991. Most of my records for A. ericoides involve var. falcatus. (Vars. falcatus and ericoides are treated as separate species in William A. Weber's latest floras and some other floras, and some floras even divide ericoides into four species. I have examined hundreds of these Aster and it is my opinion that there is genetic polymorphism for spreading vs. appressed hairs [other characters of head size and petal number seem very weak] so that different types grow in the same meadow and some plants are intermediate. Whatever the case, the butterflies cannot tell the difference between them.) Egg clusters and larval clusters found on A. ericoides var. falcatus (10 clusters of 33, 74, 52, 48, 98, 33, 64, 80, 88, 57 eggs plus ~50 1st-2nd-stage larvae found on one seedling; eight clusters of 38, 58, 76, 28, 89, 74, 235, 55 eggs on another seedling; two clusters of 135, 81 eggs found on another seedling; other clusters of 36, 19, 57, 32, 18, 57, 26, 14, 47, 118, 46 eggs found on other individual seedlings); all the eggs were on leaf undersides of lush seedlings near the ground, the most eggs being on a large 1st-year basal rosette; several Aster hesperius searched had no eggs; Green Mtn., Jefferson Co. Colo., Sept. 17, 1991. Adults associated with A. ericoides; Horsetooth Res., Larimer Co. Colo. May 23, 26, 28, 1990. Adults associated with A. ericoides common and Aster hesperius ~4 plants; Wheatridge, Jefferson Co. Colo., Aug. 6, 1990. Preoviposition 11:00 A. ericoides, Green Mtn., Jefferson Co. Colo., Sept. 1, 1990. Adults associated with A. ericoides, N Bear Creek Res., Jefferson Co. Colo., Sept. 24, 1990. Cluster of ~80 eggs found on underside of leaf of seedling Aster hesperius along canal, some reared to adults emerged Dec. 17-31; A. hesperius grows only along creeks and ditches, where larvae could be washed away, so it is a less-common hostplant than A. ericoides which occurs in moist meadows and roadsides and is more common; Barr Lake, Adams Co. Colo., Oct. 11, 1989. 2 preovipositions on Aster (Eucephalus) glaucodes (W) and adults common near it, Green Mtn. Res., Summit Co. Colo., July 15, 1985. In Colo. occupies both the plains (where the host is mainly A. ericoides, sometimes A. hesperius, evidently sometimes Machaeranthera pattersoni) and the mountains (where several Aster and the related Machaeranthera are hosts). Usually occurs in drier areas than P. tharos/morpheus; the latter also occupies both the plains and mountains, but as different sp./ssp., and generally in moist meadows and creeksides. EGG yellowish-cream. MATURE LARVA (Colo.) dark-brown (overall appearance a little darker than P. tharos/morpheus), with tiny cream dots, a middorsal blackish line through BD1 scoli, a narrow brown band, a dark-brown line of dashes that clasp upper part of BD2 scoli, a subdorsal cream line through BD2 scoli (this line is

interrupted somewhat between segments, unlike the continuous band of P. tharos/morpheus), a wide dark-brown band (dark brown near scoli, brown in intersegmental area) includes BSD scoli (and has more cream dots above BSD scoli that form a trace of a paler line through the middle of this band), a wide lateral cream-brown band is formed of a cream-tan line at lower edge of BSD scoli above spiracles, and a wide tan or light-brown band that includes spiracles and BL scoli, and a cream lateral stripe at lower edge of BL scoli, this stripe sharply-outlined beneath by brown in the middle of each segment, underside light brown with cream dots, scoli dark-brown except BL and BSV scoli tan, and ventral base of BD2 scoli slightly orange-brown, base of BL scoli orange-brown; head black, a subdorsal cream stripe on top of head often with a small cream dot at its anterior end on vertex (the stripe and dot sometimes fused), a cream stripe (weak in some larvae) on side of head from neck to above eyes, frontoclypeus black (P. tharos/morpheus tharos and morpheus have a white area on frontoclypeus). PUPA (Colo.) mottled brown (overall appearance a little darker at least in some pupae than P. tharos/morpheus), wing mostly cream or tan with brown areas in discal cell, along inner margin, and prior to apex, with small bumps on T2-3 and abdomen, a crest runs from tornus up and over A4 (the front slope of crest brown, the rear cream connected to the cream area on wing), similarly-colored smaller crests on A5-7 and T2, a sublateral blackish-brown abdomen band, a midventral narrow blackish-brown abdomen band, pale-tan postmedian & marginal wing dots.

Phyciodes picta Edw. Ovipositions 10:00-10:15 (~105 eggs), 10:37 (66 eggs), 11:02 (10 eggs before I interrupted her), 11:16 (2 eggs before I interrupted her), 12:30 (7 eggs before I interrupted her), preovipositions 10:10, 11:30, 12:00, 13:00, all on Convolvulus arvensis; ten egg clusters (6, 12, 15, 30, 40, 40, 52, 61, 92, 140 eggs per cluster) and 1 1st-stage larva found on underside of C. arvensis leaves; 7 larvae and 1 pupa found under boards and dried horse pies near C. arvensis, 1 pupal shell found on C. arvensis; 10 eggs found on underside of leaf of Cardaria draba (Brassicaceae; W), all Toll Creek, Highline Canal, Arapahoe Co. Colo., Aug. 12 & 16, 1978. Lab larvae ate C. arvensis well and Aster laevis var. geyeri well, ate a little of Aster porteri and Machaeranthera pattersoni but did not prefer these, and refused Erigeron divergens (W) and Aster falcatus (W) and Tragopogon dubius (W) and Podospermum laciniatum (W) (the latter four were the only Asteraceae found in same field). P. picta probably originally fed on Aster, and it still eats Aster in the lab, but the natural host is now Convolvulus, a remarkable case of host switching. Adults associated only with C. arvensis along railroad tracks, near Howard, Fremont Co Colo., Aug. 3, 1973 (eggs laid on this plant in lab from this site). Adults associated only with C. arvensis, E Canon City, Fremont Co. Colo., July 7, 1970, Aug. 17, 1970, July 1, 1971, July 19, 1972. Adults associated with C. arvensis, McElmo Creek, 10 mi. E Utah line, Montezuma Co. Colo., Aug. 25, 1977. Because C. arvensis is a weed, P. picta would be a good biological control agent, but unfortunately it is too limited in its choice of habitat, and refuses to populate gardens and cultivated fields. MATURE LARVA (Toll Creek) yellowish-brown with tiny cream dots, a middorsal dark-brown line, a dark-brown line along upper edge of BD2 scoli, a subdorsal cream band along BD2 scoli, a wide blackish-brown band from below BD2 scoli to lower edge of BSD scoli (this band has cream dots frequent just above BD2), a cream line at lower edge of BSD scoli just above spiracles, a band of red-brown spots in cream surroundings just below spiracles, a lateral cream ridge, a dark-red-brown line just below it, underside grayish-tan, prolegs tan, scoli brown except BL and BSV scoli tan; head dark-brown, a cream subdorsal stripe, a cream crescent above and in front of eyes, the face cream. PUPA light mottled brown, similar to other Phyciodes.

Heliconiini (=Argynnini)

Boloria. Determining the hosts of Boloria is difficult because females oviposit rather haphazardly and the larvae of most species are somewhat polyphagous in the lab, suggesting that native larvae may be able to eat up to half the herbs and young shrubs present at a locality. Field associations are therefore valuable. The plants at each locality form a preference ranking from main hostplants, to occasional hostplants, to occasional oviposition plants never eaten by larvae, to plants never chosen by females or larvae. Logic argues that the following criteria are necessary to demonstrate that a plant species is a main hostplant of a butterfly which oviposits somewhat haphazardly: 1) adults should oviposit near (or on) the plant in nature (so of course adults must be associated with the plant in nature); 2) larvae must eat (and survive on) the plant in the lab. In order to prove 1), all plants near an oviposition/larva must be recorded and the distances noted. In order to prove

2), lab feeding tests must be conducted. Plants that are eaten in the lab, but are less often oviposited near in nature or are less often associated with adults in nature, can be considered occasional hostplants which the larvae occasionally wander to and eat. Plants that females occasionally oviposit on but larvae refuse are occasional oviposition-site non-hostplants; these plants are of very little interest because haphazard oviposition guarantees many of them. So, lab feeding studies are needed to confirm that an oviposition site is a hostplant, and additional data such as ovipositions and adult association data are required to rank lab-proven hostplants as main hostplants and occasional hostplants. We will have a good picture of Boloria ecology only when main hostplants are determined by these two criteria.

A curious aspect of Boloria is that most species may have very similar lab host preference, despite great differences in hosts chosen in nature. I found that B. frigga and B. eunomia have nearly identical lab preferences, and Clyde Gillette found that B. freija has nearly the same preferences: they all eat Violaceae, Vaccinium, Polygonaceae, Rosaceae, Salicaceae (though Gillette found that freija refused one Salix sp. but ate Betula); they refuse Ranunculaceae, Gentianaceae, Apiaceae, Crassulaceae, Scrophulariaceae, and Asteraceae. B. bellona is the only species that seems to be monophagous (to Viola) based on lab feeding tests, though B. selene and some others may be monophagous also.

In 1988 and afterward, all plants near an egg were recorded and their distances (cm) to the egg noted, up to 1 m (for instance, "Sibbaldia procumbens 4, 5, 5, 6, 7, 8, 10, etc."); this system is necessary for species which oviposit somewhat haphazardly.

The arctic/alpine species seem to hibernate as unfed stage 1 and unfed stage 4 larvae during successive winters, and in artificial lab conditions stage 1 larvae often bypass diapause but stage 4 larvae always diapause (alpine/subalpine B. titania diapauses in 1st stage but is probably biennial and also diapauses in 4th stage); apparently lower-altitude (up to subalpine) species only have the unfed stage 4 diapause. An exception is that B. eunomia diapauses in the 3rd stage.

B. frigga, B. freija, B. eunomia, and B. titania could have annual life cycles, because their diapause stage of 4th, 4th, 3rd, and 1st stage larva nicely fits their time of appearance in nature: B. frigga and freija fly first (June-July, peak late June), B. eunomia flies next (July-mid Aug., peak late July), B. titania flies last (mid July-early Sept.; but they could be biennial, see below for discussion of biennial titania life cycle).

Boloria napaea halli Klots. Adults associated strictly with Polygonum (Bistorta) bistortoides in moist meadows and gentle slopes along valley bottoms, always with dense short flowery vegetation, at two sites on the western slope (Sublette Co.) and two sites on the eastern slope (Fremont Co.) of Wind River Mts., Wyoming, Aug. 12, 1979, Aug. 9, 1980, Aug. 11-12, 1983. This plant is closely related to Polygonum (Bistorta) viviparum, the known host in Europe and arctic America, which has also been recorded as a host in Wind River Mts. (Jim Troubridge); P. viviparum is usually more common than P. bistortoides, though individual plants are smaller, so perhaps P. viviparum is the most common host here.

Boloria eunomia caelestis (Hemm.). 17 ovipositions were seen. Oviposition 9:19 2 eggs in cluster, oviposition 9:50 3 eggs in cluster, both on underside of leaves of Thalictrum alpinum, oviposition 9:00 2 eggs in cluster on underside of leaf of 5 cm tall plant of Pentaphylloides floribunda, Caribou, Boulder Co. Colo., July 16, 1977. Oviposition 9:13 4 eggs in cluster on underside of Caltha (Psychrophila) leptosepala (W) leaf, Loveland Pass, Summit Co. Colo., July 17, 1977. Unfortunately, nearby plants were not recorded for these records, so most of the potential information on hostplant was lost. Oviposition 9:05 one egg on small Viola labradorica (=bellidifolia)(W) plant, Loveland Pass, Summit Co. Colo., July 28, 1978. Oviposition 9:26 seven eggs in compact cluster on underside of leaf of Salix planifolia seedling (S. planifolia common nearby, Salix brachycarpa 20-30 cm away, Salix wolfii 30-1 m, Betula glandulosa 20-60, 60-80 cm away, Pentaphylloides floribunda 10, 15, 50-1 m away), oviposition 10:05 one egg on underside of Thalictrum alpinum (T. alpinum common nearby, Salix brachycarpa common nearby 5 cm onward, Salix planifolia 40-1 m, Salix wolfii 15, 30-1 m, 40-1 m away, Pentaphylloides floribunda 5-30, 1 m, Betula glandulosa 90, Fragaria [or Sibbaldia?] 25, 90, 1 m away, Polygonum [Bistorta] bistortoides 40 cm away), oviposition 10:22 five eggs in cluster on underside of Thalictrum alpinum (T. alpinum common nearby, Salix planifolia common 5-1 m, Pentaphylloides floribunda 80-90, Betula glandulosa 80, 90), Caribou, Boulder Co. Colo., July 5, 1988. Oviposition 10:15 four eggs on underside of 6 mm-wide Caltha leptosepala seedling (possibly Viola labradorica as these seedling leaves are very difficult to tell apart)(C. leptosepala common 2 cm onward, Salix

planifolia shrubs 20 cm onward), preoviposition 11:15 on underside of Polygonum
(Bistorta) viviparum tiny seedling (P. viviparum common nearby, Vaccinium
cespitosum common 5 cm onward, Salix planifolia common 10 cm onward),
 preoviposition 11:25 near Polygonum viviparum (P. viviparum common nearby, Salix
planifolia 5 cm onward), oviposition 11:36 three eggs on underside of 4 mm-wide
Polygonum viviparum seedling leaf, (P. viviparum common 1 cm onward, Salix
planifolia seedlings 10 cm onward), Loveland Pass, Summit Co. Colo., July 23,
 1988. Oviposition 10:18 three eggs on underside of 4 mm-wide Polygonum
viviparum seedling leaf (P. viviparum common nearby 0.5 cm onward, Sibbaldia
procumbens 4, 12, 30, Viola labradorica 3, 8, etc. onward common, Salix
planifolia 15 cm onward, Kalmia [polifolia] microphylla 5 cm), Loveland Pass,
 Summit Co. Colo., July 28, 1988. Oviposition 11:16 three eggs on underside of
Polygonum viviparum 4 mm-wide seedling leaf (P. viviparum common nearby 1 cm
 onward, Polygonum bistortoides 20 cm away, Salix planifolia 7, 20 cm onward,
Potentilla diversifolia 18-25 cm, Vaccinium cespitosum 70, Viola labradorica 65,
 80), oviposition 13:56 three eggs on underside of leaf of Vaccinium myrtillus
oreophilum seedling (V. m. oreophilum common all around, Viola labradorica
 common 4 cm onward, Polygonum bistortoides common 15 cm onward, Potentilla
diversifolia 15-45 cm, Salix planifolia 35, 80, 1 m, Polygonum viviparum 13 & 30
 cm), Loveland Pass, Summit Co. Colo., Aug 1, 1988. Oviposition 12:50 two eggs
 on underside of Polygonum viviparum 4 mm wide seedling leaf (P. viviparum very
 common 1 cm onward, Salix planifolia 8, 25 cm onward, Viola labradorica 22-45),
 preoviposition 9:44 among Salix planifolia & Polygonum viviparum, Loveland Pass,
 Summit Co. Colo., Aug 2, 1988. Preoviposition 10:30-10:33 among Vaccinium
cespitosum on old lichen mound (V. cespitosum common nearby, Viola labradorica
 3, 5, 8, 15, 20 cm away, Polygonum viviparum 15, 25 cm away, Salix planifolia 20
 cm away), oviposition 10:34 three eggs in cluster on underside of Polygonum
viviparum seedling leaf (P. viviparum common 5 cm onward, Vaccinium cespitosum
 common 3 cm onward, Salix planifolia 10 cm onward, Viola labradorica 12 cm
 onward), Loveland Pass, Summit Co. Colo., Aug 5, 1988. Oviposition 13:30 two
 eggs in cluster on underside of Vaccinium cespitosum leaf (V. cespitosum very
 common 0-1 m, Polygonum bistortoides 5 cm onward, Potentilla diversifolia 15 cm
 onward, Salix planifolia 25, 70-90 cm), Loveland Pass, Summit Co. Colo., Aug 8,
 1988. Oviposition 15:14 two eggs in cluster on underside of Viola labradorica
 leaf (V. labradorica very common 0-1 m, Vaccinium cespitosum 45 cm onward,
Sibbaldia procumbens 1 m, Polygonum bistortoides 80, Salix planifolia 60, 1 m),
 Loveland Pass, Summit Co. Colo., Aug 19, 1988. Larvae are somewhat polyphagous,
 eating these plants well in the lab: Salix planifolia, Salix drummondiana, Viola
labradorica, V. sororia affinis (=nephrophylla), Polygonum viviparum, Polygonum
bistortoides, Vaccinium cespitosum, Sibbaldia procumbens. Larvae eat some of
Potentilla diversifolia, and eat a little of Pentaphylloides floribunda and
Kalmia (polifolia) microphylla. Larvae do not eat any of Thalictrum alpinum,
Caltha leptosepala (ate only two bites out of this), Swertia perennis, Angelica
grayi, Sedum (Clementsia) rhodanthum, Pedicularis groenlandica, Eriogon
ursinus, Senecio. Based on these oviposition records and adult association and
 the lab feeding tests, Polygonum viviparum is a main hostplant, evidently most
 often chosen; Polygonum bistortoides may be an occasional hostplant. Salix
planifolia is also a main hostplant, based on several ovipositions and presence
 near many eggs; Salix brachycarpa is an occasional hostplant, chosen less often
 because it is less common in the willow bogs. Another factor indicating Salix
 as a major host is that adults usually occur in shrub-willow bogs; perhaps Salix
 is an important host in early summer when larvae are large and require a lot of
 food which the Salix shrubs provide (Polygonum viviparum and Viola labradorica
 are very small plants to supply the needs of 1-7 larvae). However, a colony was
 found near Divide, Teller Co., Colo. (July 1990, Eric Schonberg) in a horse
 pasture without any Salix, which is possible because larvae are polyphagous.
Viola labradorica is also a main hostplant, based on several ovipositions and
 presence near many eggs. Vaccinium cespitosum and Vaccinium myrtillus are
 occasional hostplants, V. cespitosum undoubtedly used more often because it
 often grows in drier areas within the willow bogs whereas V. myrtillus usually
 grows only under spruce trees at bog edges. Several Rosaceae (Potentilla
diversifolia, Sibbaldia procumbens, Pentaphylloides floribunda) could be seldom-
 used occasional hostplants, merely based on their presence near several eggs and
 lab feeding; but P. floribunda is unlikely because larvae do not eat it well.
 In conclusion, B. eunomia is truly polyphagous in nature as well as in the lab.
 Females oviposit in clusters! of 1-7 eggs on underside of small (typically about
 4-10 mm wide) green leaves of seedling plants near the ground in marsh "grass"
 or grassy areas between willow shrubs; they crawl around on the ground to locate
 such a leaf and fly if they do not find one. Eggs hatch after 6 days in the
 lab. 3rd-stage larvae hibernate. Early stages: EGG pale yellow. FIRST STAGE

LARVA tan (becoming green due to food), A1, A3, A5, A7 browner forming rings around body, seta bases black; head black. 2ND STAGE LARVA mottled brown (body tan, with browner patches in subdorsal areas between scoli), scoli dark brown; head black. 3RD STAGE LARVA red-brown with dark-brown marks, except area above BD2 scoli to just above BSD1 scoli tan with dark-brown crescents extending posterodorsally and posteroventrally from each BSD1, a middorsal band of brown lenslike marks, a lateral cream line on A2-8 below BL1 scoli (an anterior white crescent on A1, a lateral dash on T1 & T3), a brown crescent above BSV1 scoli, pale-red-brown crescent above proleg; head dark-brown-black with a red-ochre zone around eye area, a red-ochre stripe on each vertex, a red-ochre lenslike patch on lower front.

Boloria selene myrina (Cramer) (= tollandensis [B. & B.]). Oviposition Viola sp., wet grass/sedge meadow with scattered willows SW Westcliffe, Custer Co. Colo. Aug., 1970. Female laid eggs in lab reared to adults on Viola sororia affinis (= nephrophylla), Fraser, Grand Co., Colo., Aug. 5, 1991. 1ST-STAGE LARVA cream, with brown seta bases, suranal plate & collar blackish; head black. 3RD-STAGE LARVA gray, many large black conical scoli, suranal plate & collar black; head black. MATURE LARVA black with usual markings for the species, but the scoli bases slightly-orangish-cream (very little orange), the long prothoracic scoli shorter than those of myrina = sabulocollis (about same length as head width). PUPA black-brown, blacker than "sabulocollis", the golden cones and other cones shorter (merely conical with no nipple at tip).

Boloria selene myrina (Cramer) (= sabulocollis Kohl.). Adults associated with Viola pratincola? Pursh, Smith Lake, Sheridan Co. Neb., July 17, 1986. Adults associated with Viola sororia affinis (= nephrophylla), Timnath, Larimer Co. Colo. (this tiny population became extinct about 1980 when removal of horses permitted overgrowth of Phragmites). Adults associated with Viola sororia affinis (= nephrophylla), Elbert Co. Colo., 1972-1984. A weak ssp. with some adults slightly browner on unh base; a Las Animas Co. Colo. mtn. population has browner unh base but is small like tollandensis. MATURE LARVA (Scott 1986, plate 3) black with usual markings for the species, but the scoli bases orange (much oranger than "tollandensis"), the long prothoracic scoli much longer than those of "tollandensis" (about 1.5 times head width). PUPA (Scott 1986, plate 5) fairly dark brown, lighter than "tollandensis", the golden cones and other cones longer (conical plus a protruding nipple at tip).

Boloria selene myrina. Adults associated with Viola papilionacea (now often treated as a ssp. of V. sororia); NE Alden, Freeborn Co. Minn., June 10, 1990.

Boloria titania helena (Edw.). 33 ovipositions were seen. Oviposition 13:50 on young plant of Viola labradorica (W), Loveland Pass, Summit Co. Colo., July 27, 1978. Oviposition 10:40 on stem of Vaccinium scoparium (W), near Jenny Creek, Rollins Pass, Gilpin Co. Colo., Aug. 5, 1978. Oviposition 10:51 at base of stem of Trollius (laxus) albiflorus (W) (this plant is doubtfully eaten by larvae) (Polygonum [Bistorta] bistortoides common there also and the probable host, nearest Salix 3 m away), Rollins Pass, Gilpin Co. Colo., Aug. 4, 1977. Oviposition 13:34 on grass blade within 3 cm of Polygonum bistortoides, Potentilla sp., and grass, W Hoosier Pass 11800', Park Co. Colo., July 30, 1982. Oviposition 9:46 on underside of Kalmia (polifolia) microphylla (K. microphylla very common nearby 1 cm onward, Salix planifolia bushes 20 cm onward), oviposition 10:40 underside of sphagnum? moss (Salix planifolia shrubs 10 cm onward), Loveland Pass, Summit Co. Colo., July 26, 1988. Oviposition 9:26 on 7 mm-thick twig 12 cm above ground (Vaccinium cespitosum 0, 12 cm onward common, Viola labradorica 0, 15 cm onward common, Polygonum bistortoides 8 cm onward, Potentilla diversifolia 5, 15 cm onward, Salix brachycarpa 40, 80), oviposition 9:27 on underside of Salix brachycarpa twig 15 cm above ground (S. brachycarpa common nearby 0-90, Polygonum bistortoides 5, 5, 20 cm onward, Potentilla diversifolia 12 cm onward, Vaccinium cespitosum 10 cm onward, Polygonum [Bistorta] viviparum 5, 15 cm onward, Viola labradorica 18), oviposition 11:36 on underside of Veronica (wormskjoldii) nutans leaf (V. nutans common 3 cm onward, Viola labradorica common 1 cm onward, Vaccinium cespitosum 5 common cm onward, Polygonum viviparum 40, 40-50, 90), oviposition 12:40 on underside of Penstemon whippleanus young leaf (P. whippleanus very common 3 cm onward, Vaccinium myrtillus oreophilum very common 1 cm onward), oviposition 12:49 on underside of dead grass blade beside Vaccinium myrtillus oreophilum (V. m. oreophilum common 3 cm onward, Polygonum bistortoides one plant 3 cm away, Viola labradorica 10, 15, 20 cm onward), Loveland Pass, Summit Co. Colo., Aug. 1, 1988. Oviposition 10:45 on narrow green grass leaf (Viola labradorica common 1 cm onward, Salix planifolia 7, 25 cm onward, Polygonum viviparum 25, 50, 65, Potentilla diversifolia 30, 70), oviposition 12:00 on underside of Vaccinium myrtillus oreophilum seedling leaf (V. m. oreophilum common 2 cm onward, Potentilla diversifolia 30-45, Polygonum bistortoides 7, 25 cm onward), Loveland

Pass, Summit Co. Colo., Aug. 2, 1988. Oviposition 11:35 on underside of dead Salix planifolia leaf (under S. planifolia canopy, and S. planifolia plants 12 cm onward, Polygonum viviparum 10, 20 cm, Potentilla diversifolia 4 cm onward, Sibbaldia procumbens 15-30 cm), oviposition 12:48 on underside of Vaccinium scoparium leaf (V. scoparium or Vaccinium myrtillus oreophilum common 2 cm onward, Polygonum viviparum common 18 cm onward, Salix planifolia 50, 70, Polygonum bistortoides 90, 1 m), oviposition 13:51 on Picea engelmannii needle in litter (Vaccinium myrtillus oreophilum very common 1 cm onward, Gaultheria humifusa very common 2.5 cm onward, Polygonum bistortoides 8, 40, 90 cm, Polygonum viviparum 25 cm, Vaccinium scoparium 12, 20 cm onward, Kalmia [polifolia] microphylla common 28-50 cm), Loveland Pass, Summit Co. Colo., Aug. 5, 1988. Oviposition 11:06 on underside of 4 mm wide leaf of Vaccinium scoparium seedling (V. scoparium very common nearby 0-1 m, Vaccinium myrtillus oreophilum common 5 cm onward, Polygonum viviparum 90, Salix planifolia 1 m), oviposition 11:08 on underside of 4 mm leaf of Vaccinium scoparium seedling (V. scoparium common 5-55 cm, Vaccinium myrtillus oreophilum very common 2 cm onward, Salix planifolia 75), oviposition 11:40 on underside of Vaccinium cespitosum leaf of seedling (V. cespitosum very common 1-1 m, Salix reticulata nivalis 7 cm onward, Viola labradorica 2 cm onward, Salix planifolia 22 cm, Polygonum bistortoides 20 cm, Potentilla diversifolia 80), oviposition 11:41 on underside of leaf of Vaccinium myrtillus oreophilum seedling (V. m. oreophilum 8 cm onward, Vaccinium cespitosum common 4 cm onward, Polygonum viviparum 8 cm onward, Vaccinium scoparium 50 cm, Viola labradorica 10-45 cm, Sibbaldia procumbens 20 cm onward, Salix reticulata nivalis 15 cm onward, Potentilla diversifolia 90), Loveland Pass, Summit Co. Colo., Aug 8, 1988 (J. Scott and Marc Epstein). Oviposition 11:00 on underside of Gentianella acuta leaf (G. acuta 2 cm onward, Sibbaldia procumbens 10 cm onward, Vaccinium myrtillus oreophilum 15 cm onward, Viola labradorica 15 cm onward, Polygonum viviparum 14 cm onward), oviposition 12:20 on underside of 7 mm leaf of Gaultheria humifusa (G. humifusa very common 0-1 m, Vaccinium cespitosum common 3 cm onward, Sibbaldia procumbens common 0.5 cm onward, Salix reticulata nivalis 6 cm onward, Polygonum viviparum 18, 25, 60 cm, Polygonum bistortoides 6 cm onward, Viola labradorica 40-90), Loveland Pass, Summit Co. Colo., Aug 10, 1988. Oviposition 10:27 on underside of dead leaflet base of Potentilla diversifolia (P. diversifolia common 0 cm onward, Viola labradorica 0 cm onward, Vaccinium myrtillus oreophilum common 2 cm onward, Polygonum viviparum 20 cm onward), oviposition 10:40 on oval-cross-section rubbery green sedge leaf (Polygonum viviparum common 5 cm onward, Viola labradorica common 2 cm onward, Salix planifolia common 8 cm onward, Kalmia [polifolia] microphylla 20 cm onward, Potentilla diversifolia 22 cm onward), Eisenhower Tunnel, Summit Co. Colo., Aug. 15, 1988. Oviposition 10:35 on underside of leaf base of Erigeron ursinus seedling (E. ursinus common 3 cm onward, Polygonum viviparum 7 cm onward, Sibbaldia procumbens 8 cm onward, Vaccinium myrtillus oreophilum common 3 cm onward, Gaultheria humifusa very common 2 cm onward, Viola labradorica 9 cm onward), oviposition 11:10 on underside of sphagnum? moss (or ?Minuartia obtusiloba) (Polygonum viviparum common 2 cm onward, Viola labradorica 2-18 cm, Gaultheria humifusa 7-25 cm, Vaccinium cespitosum common 3 cm onward, Salix reticulata nivalis common 3.5 cm onward, Sibbaldia procumbens 13-50 cm), oviposition 13:31 on top of Vaccinium cespitosum leaf (V. cespitosum common 0-1 m, Salix reticulata nivalis 0.5 cm onward, Viola labradorica 28-80 cm, Polygonum viviparum 50), oviposition 14:27 on underside of petiole of Erigeron ursinus seedling (E. ursinus common 0-45 cm, Salix reticulata nivalis 3 cm onward, Vaccinium cespitosum common 2 cm onward, Viola labradorica 20 cm), Loveland Pass, Summit Co. Colo., Aug 18, 1988. Oviposition 11:37, the female landed on Salix reticulata nivalis and crawled 5 cm and laid egg on underside of Vaccinium cespitosum leaf (V. cespitosum common 5 cm onward, S. reticulata nivalis common 3 cm onward, Viola labradorica 10, 30, 30, 60 cm, Sibbaldia procumbens 22 cm), oviposition 12:35 on underside of dead Trifolium dasyphyllum leaf (T. dasyphyllum common 1 cm onward, Vaccinium cespitosum very common 1 cm onward, Vaccinium myrtillus oreophilum 3 cm onward, Gaultheria humifusa 1 cm onward, Viola labradorica 5-35 cm, Polygonum viviparum 40 cm, Salix planifolia 30 cm onward, Sibbaldia procumbens 45-60 cm, Salix reticulata nivalis 30 cm, Polygonum bistortoides 35 cm, Potentilla diversifolia 9 cm onward), oviposition 12:36 on top of Vaccinium cespitosum leaf (V. cespitosum common 3 cm onward, Vaccinium myrtillus oreophilum common 0.5 cm onward, Salix reticulata nivalis 6 cm onward, Sibbaldia procumbens 4-50 cm, Viola labradorica 17, 35 cm, Polygonum viviparum 40, 50, Polygonum bistortoides 10, 22, 60), oviposition 14:31 on underside of Vaccinium scoparium stem (V. scoparium very common 5 cm onward, Vaccinium myrtillus oreophilum common 15 cm onward, Viola labradorica 35 cm, Potentilla diversifolia 1 m), Loveland Pass, Summit Co. Colo., Aug 19, 1988. Oviposition

10:20, she fluttered slowly over alpine tundra on ridge then landed in middle of Salix reticulata nivalis patch and bent abdomen, flew 30 cm to another part of S. r. nivalis patch and probed with abdomen there and an egg was found there in litter (S. r. nivalis 0.5 mm-90 cm, Erigeron ursinus 1, 8, 15 cm etc. scattered, Geum (Acomastylis) rossii turbinata 0.5, 3, 3, 4, 5, etc. abundant to 100, Potentilla diversifolia 20), then she flew 20 cm and probed again on S. r. nivalis (I could not find an egg at this spot), she flew 5 m to another S. r. nivalis patch and landed and possibly laid another egg (I failed to watch closely enough to see), Loveland Pass, Clear Creek Co., Colo., July 19, 1989. Preoviposition fluttering on Salix reticulata nivalis, Uncompahgre Peak, Hinsdale Co. Colo., Aug. 3, 1979, and Hermit Pass, Custer Co. Colo., July 1970. Females oviposit somewhat haphazardly, so lab feeding tests are needed. Unfortunately, few lab feeding tests have been done (except my young lab larvae ate Viola but not Salix babylonica) because first-stage larvae diapause and then die in the lab, so some plants near the eggs that were recorded in my notes have not been listed here but may later prove to be edible to larvae. However, the oviposition records and field association of adults very clearly show that Vaccinium is the favorite hostplant genus by far. Vaccinium myrtillus, Vaccinium cespitosum, and Vaccinium scoparium are all popular as oviposition sites: adults occur most commonly at the edges of bogs and the edges of streams and semishaded valley bottoms where they can oviposit on V. myrtillus and V. scoparium growing under and around spruce trees; out in the open females like to oviposit on V. cespitosum. Viola labradorica is a frequent host, with several ovipositions and occurrences near many other eggs, and larvae eat it. Polygonum bistortoides and Polygonum viviparum are surely occasional hostplants, and larvae probably eat them. Salix reticulata nivalis is a frequent host above timberline, rarely below. Salix planifolia and Salix brachycarpa are probably occasional hostplants, if larvae eat them. Gaultheria humifusa and Kalmia polifolia have one oviposition apiece, and several eggs were near the former, but they can be called occasional hostplants only if larvae are found to eat them, because their leaves are rather tough. Potentilla diversifolia and Sibbaldia procumbens were very near several eggs, so are probably occasional hosts as larvae can probably eat them. Erigeron ursinus had several ovipositions, but I doubt that larvae can eat it. Eggs are always laid singly, usually on green plant leaves of young or low plants. First-stage larvae hibernate. The life cycle could be annual, 1st-stage larvae overwintering to cause the late summer adult flight. However, W. Edwards (Can. Ent. 22:62) found that Colo. larvae hibernate in the 4th stage, Alberta larvae in 1st stage and 4th stage. If we believe both my and Edwards' data, larvae diapause in 1st and 4th stage in Colo. and Alta., which means that B. titania larvae must have a VERY slow developmental rate for adults to fly so late in the summer (but since eggs are usually laid near trees perhaps the snow lingers there longer thus delaying larval feeding and adult flight). B. titania often flies above timberline, where most if not all species are biennial. Early stages: EGG tan (light peach). FIRST-STAGE LARVA brown; head black.

Boloria bellona (Fabr.). Oviposition 9:29, she searched the edge of the moist meadow, and landed on Cirsium coloradense var. acaulescens and bent abdomen, then crawled 30 cm to beneath a Pentaphylloides floribunda bush and laid an egg 5 cm from bush on underside of dead horizontal grass blade (Viola adunca plant 1 m away under a 2 m tall Salix bush [the only Viola plant seen at this locality], Taraxacum officinale 2, 5, 15, 20 cm from egg etc., Ivesia 15, 20, 50, Cirsium coloradense var. acaulescens 35, 55, Fragaria sp. 5, 7, abundant 15-100, Potentilla [Drymocallis] ?fissa 80, 100, Ranunculus 80, Kochia?? 5, 10, 15, etc., Geum? 80); preoviposition 10:40 she crawled around in hollows in the marsh "grass"; Viola adunca is evidently the host here; W Tabernash, Grand Co. Colo., June 28, 1989. A female caught W Tabernash June 28 laid eggs in lab, which produced 19 adults July 28-Aug. 3, and produced diapausing larvae which were refrigerated several months and in turn produced 23 adults Oct. 24-Nov. 14; in nature there is evidently one main generation June-E July and then most larvae diapause but some larvae develop to produce the partial L Aug. flight seen in nature. ~40 of these larvae from W Tabernash were placed in one container for 2 days in lab with leaves of the following plants, and amount of larval feeding noted, with these results: Viola sororia affinis (=nephrophylla) (ate nearly all of leaves), V. adunca (ate ~65% of), Sibbaldia procumbens (ate 6 little holes in leaf for a total of only 5 mm² eaten), Salix planifolia ate none, Salix reticulata nivalis ate none, Castilleja (red flower) ate none, Castilleja occidentalis ate none, Trollius albiflorus ate none, Caltha (Psychrophila) leptosepala ate none, Potentilla diversifolia ate none, Erigeron (white flower) ate none, Erigeron (violet flower, hispid leaf) ate none, Polygonum (Bistorta) viviparum ate none, Polygonum (Bistorta) bistortoides ate none, Artemisia

scopulorum ate none, Geum rossii turbinata ate none, Vaccinium cuspidatum ate none; B. ballouana is evidently host-specific to Viola, which is amazing considering the broad host specificity of most Boloria. Unfed-4th-stage larvae hibernate. EGG conical, cream-tan. FIRST-STAGE LARVA tan on T1-2, tan-cream on T3-A6 (brownish on A1, A3, A5, A7), tan on A8-10, a middorsal brown line on T2-3, middorsal brown dash on A1-9, brown band along D1 setae, brown band along SD1 setae, probably a brown band(s) on side; pronotum and head black. OLDER LARVA dull blackish-gray, with many tiny setae each with a gray circle around seta base, on T2-3 a middorsal black fork (forked anteriorly), on A1-9 a black middorsal Y connected to Y on next segment by a 2 gray wiggly lines, below subdorsal BD2 scoli a narrow white line of subdorsal dashes (these dashes are the most conspicuous pattern on larva, the remaining pattern being less obvious), edging each white dash beneath a black band of dashes, below each black dash a short very narrow white dash just above BSD scoli which is connected to the same dash on the next segment by a white wiggly line, below BSD scoli another white wiggly line above spiracles, below BL scoli a white line on A1-10 only, a midventral weak white band (strong on A7-8, fairly strong A1-2); all scoli have black base, ochre basal half, black distal half, except BL scoli on A1-7 has black base and ochre remainder, BL on A9 is all blackish, BL on A8 is intermediate; head black except coronal sulcus white. PUPA mottled dark-brown, dorsal rim of wing blackish, a 1-mm black spot in middle of wing, brown spot near apex, veins black, on top of A5-7 is a fine white V aimed forward with anteriorly-convex arms (the anterior tip of the V is on a slight bump forming a pivot where the segment swivels from side to side, and each arm is edged anteriorly by black), a blackish abdomen band is next to midventral axis, a wider dark brown abdomen band is just above & another just below lateral axis of abdomen; a T2 middorsal keel has blackish sides, a middorsal ridge is strong on A5-7, weak on A3-4 & A8; many cones present (head has one cone on each side which is aimed forward and is blackish on top, pearly-gold-with-blue-sheen subdorsal cones are big on T1, tiny T2, big T3, smaller A1 & A2, brown tiny subdorsal cones are giant on A3, tiny A4-7, brown tiny cones are above spiracles on A2-7 [slightly pearly on A2], a lateral cone on forewing base has blackish top).

Boloria frigga sagata (B. & B.). 8 ovipositions were seen. Adults associated with shrub Salix (S. planifolia commonest, geyeriana and monticola common, wolfii, brachycarpa, and drummondiana uncommon) in a willow-Betula glandulosa bog, only one Viola labradorica plant found, no Ericaceae seen in bog, Jefferson Creek, Park Co. Colo., June 7, 23, 1988; S. planifolia and other Salix are the probable hosts here. Oviposition 9:18 on underside of dead brown horizontal 4 mm-wide coarse marsh "grass" between Salix planifolia shrubs (S. planifolia shrubs 70 cm and 1 m away, Geum macrophyllum seedling 15 cm away, Galium trifidum brevipes 40, 50, 60 cm away, Betula glandulosa 90 and 100 cm away), oviposition 9:55 on underside of green horizontal leaf of 4 mm wide marsh "grass" on small mound beside creek, under Salix planifolia seedlings (S. planifolia 0-100 cm away, Salix wolfii 35-100 cm away, Betula glandulosa 20 cm onward, Pentaphylloides floribunda 25, Sibbaldia procumbens 90), preoviposition 9:50 marsh grass (Salix wolfii 60 cm away, Sedum 5 cm away, Betula glandulosa 20 cm away), preoviposition 9:54 on marsh grass clump beside creek, 10 cm from Salix planifolia seedlings, preoviposition 10:50 (I scared her away by getting too close) on marsh grass (S. planifolia 20 cm away), all willow bog S of Breckenridge, Summit Co. Colo., June 28, 1988. This willow bog had Salix planifolia very common, S. wolfii common in certain spots, S. monticola uncommon, S. drummondiana rare, Betula glandulosa common, Viola and Polygonum not seen. Ovipositions 9:45 one egg on underside of 4 mm wide dead marsh "grass" blade, and the female crawled 2 cm away and oviposited 9:46 one egg on underside of dead marsh "grass" stem, both eggs under and among Salix brachycarpa seedlings (S. brachycarpa common nearby, one tiny Salix monticola seedling 5 cm away, Betula glandulosa 40, 80 cm away), oviposition 10:09 in litter under Salix brachycarpa seedlings (S. brachycarpa common nearby, Salix monticola seedling beside egg and another 10 cm away, Salix wolfii 45, 90 cm away, Betula glandulosa 5 and 25 cm away), oviposition 14:59 on bark hanging from 7 mm-wide dead horizontal twig 4 cm above ground (Salix wolfii common nearby from 8 cm [small plants] to meters away, Salix brachycarpa 75 cm and farther away, Pentaphylloides floribunda 10-40, 50 cm, Galium trifidum 2-50), preoviposition 10:47 beside Salix brachycarpa and Salix monticola seedlings, preoviposition 11:07 at base of Salix brachycarpa (common nearby) seedlings, preoviposition 13:08 under Salix wolfii 30-cm-tall plants (S. wolfii common nearby, Pedicularis groenlandica found there also), all N Alma, Park Co. Colo., July 1, 1988. This willow bog had Salix brachycarpa commonest, Salix wolfii and Salix monticola common in certain spots, Salix planifolia uncommon though common

Ericaceae were seen. Oviposition 12:58 one egg on underside of horizontal dead marsh "grass" leaf on moss mound about 1 m from creek and 2/3 m from Betula glandulosa-Salix wolfii bush (Salix planifolia seedlings common 1.5 cm-1 m, S. wolfii 50 cm 1 m, Betula glandulosa one seedling 10 cm away, shrub 50-1 m, Polygonum (Bistorta) bistortoides 1-50 cm away, Fragaria (Sibbaldia procumbens?) 10 & 25 cm away, Galium trifidum 20 cm away), preoviposition 12:57 bent abdomen on underside of dead blade of marsh "grass" between Salix wolfii and Salix planifolia-Betula glandulosa bushes (S. planifolia seedlings common 5, 12, 8-1 m, S. wolfii 30-70, 60-1.5 m, Betula glandulosa 40-1 m), Caribou, Boulder Co., Colo., July 5, 1988. Oviposition 10:10, she previously preoviposited at 10:09 by bending abdomen under a dead grass blade on a mound containing Salix planifolia seedlings (S. planifolia abundant 0-200 cm), then flew to a hummocky bog opening 4 X 10 m wide with lots of marsh "grass", and landed and laid an egg at 10:10 under dead horizontal gray grass blade 2 cm from a 10-cm-tall Salix planifolia seedling (S. planifolia seedlings very abundant 2-100, [Salix wolfii far away 4-7 m], Betula glandulosa seedlings 35-90, bushes 15, 100, Polygonum [Bistorta] viviparum 17, Sibbaldia procumbens 30, 30, 80, Sedum rhodanthum 35, 45, 45, 60, Umbelliferae sp. 2?, 35, 95, Thalictrum alpinum 15, 65, 80, Pentaphylloides floribunda 55-70, 90, 100), Caribou bog, Boulder Co. Colo., July 2, 1989. The main hostplant at Caribou is Salix planifolia, which was the commonest willow, Salix wolfii was also fairly common, Salix brachycarpa and Salix monticola were rare; Viola labradorica was rare here. Adults occur in willow bogs consisting mostly of Salix planifolia, with a few Salix brachycarpa at the bog edge, Loveland Pass, Summit Co. Colo., many years' data. Beaver dams are important for frigga, because females tend to oviposit near seedling Salix growing on filled-in areas of silted-up old beaver dams, silted-up oxbow ponds, and the inside of stream bends. Females roost (the wings aimed downward, the forewings between the hindwings, the antennae angled to the side about 30° just posterior to the level of the hindwing costa) and rest on older Salix shrubs, but they oviposit only in litter near seedling Salix in the spaces between shrubs. Many larvae from S of Breckenridge were reared and their lab food choice tested prior to 4th-stage diapause; various plants were simply added to the rearing jars and feeding damage noted. Larvae ate these plants well: Salix (planifolia, brachycarpa, wolfii, monticola, bebbiana, amygdaloides, exigua), Vaccinium myrtillus oreophilum, V. scoparium, Polygonum viviparum, P. bistortoides, Potentilla diversifolia, Sibbaldia procumbens. Larvae ate some Viola labradorica, some Viola sororia affinis (=nephrophylla), a little Kalmia (polifolia) microphylla. Larvae ate none of Caltha (Psychrophila) leptosepala, Anemone (Anemonastrum) narcissifolia zephyra, Swertia perennis, Angelica grayi, Sedum (Clementsia) rhodanthum, Epilobium saximontanum, Veronica (worskjoldii) nutans, Pedicularis groenlandica, Senecio sp., Eriqeron ursinus. I accept Salix planifolia, Salix wolfii, and Salix brachycarpa as main hostplants; S. planifolia is probably most commonly used because it is the commonest Salix in Colorado willow bogs. Salix monticola is undoubtedly an occasional hostplant and probably a main hostplant in some bogs, though it is local in distribution in most willow bogs and occurs also at lower altitude along streams. There is no evidence to indicate that B. frigga shows any interest in Betula, which is absent in some B. frigga bogs, and larvae are not known to eat it. Viola and Polygonum are rare or absent near B. frigga in most bogs so they cannot be main hosts, and Viola is a poor lab food; Polygonum could be an occasional hostplant. Vaccinium might be an occasional host of wandering larvae, but it and Potentilla and Sibbaldia are not closely associated with B. frigga so cannot be main hostplants. Various published hostplants of B. frigga (Betula, Andromeda, Rubus, Dryas) are probably just occasional hosts, although the arctic B. frigga gibsoni B. & McD. could possibly differ in habits and eat Dryas. There is strong evidence for Salix being the only main Colo. hostplant; adults frequently occur in willow bog areas having few plants except willow and marsh "grass". Eggs are laid singly, primarily on dead horizontal litter, usually of marsh "grass" (probably a sedge with 4-5 mm wide leaves). Unfed-4th-stage larvae hibernate. Early stages: EGG light-peach (light-orangish-tan). FIRST STAGE LARVA mottled reddish-brown or brown, legs & prolegs paler; head black. 2ND STAGE LARVA brownish-black, prothorax tan, a middorsal black line edged by a cream line, scoli black with tan bases, a cream U-shaped crescent beneath each subdorsal scoli, a faint cream line at lower edge of supralateral scoli, a cream sinuous line under sublateral scoli; head black. 3RD STAGE LARVA brownish-black, a middorsal blackish line edged by faint whitish line, a cream U under each subdorsal scoli, a cream transverse dash between the tops of adjacent U's, two rows of faint whitish dashes under supralateral and sublateral scoli; head black. 4TH STAGE LARVA black, underside blackish-brown, a sinuous

white subdorsal band curves under scoli BD2 (on T3-A7 this band contains a black spot), scoli black with ochre bases (BD scoli ochre on basal 2/3); head black. MATURE LARVA black including legs & prolegs, a subdorsal white band from T1-A10 (the white band interrupted slightly on rear of T1; inside white band on T2-A8 a blackish-brown spot precedes a smaller blackish-brown transverse dash [the latter absent A7-8, both spot and dash absent A9-10], the white band short on A10), many scoli (on T1-A9 BD1 scoli orange-ochre on basal 2/3 with black setae, tip black with black setae; on A1-7 BSD scoli brown on basal half with black setae, black on distal half with black setae; on T1-3 & A8 & A10 BSD scoli dark-brown on basal half with black setae, black on distal half with black setae; on T1-A8 BL scoli black; on T1-A8 small black bumplike BSV scoli); head black.

Boloria improba acrocnema G & S. Ovipositions 10:35, 10:45, 11:30, 12:50 on stems of Salix reticulata nivalis, Uncompahgre Peak, Hinsdale Co. Colo., July 18, 1980. S. r. nivalis is more common than S. arctica in Colo., perhaps because the alpine zone is drier than in Wyo. Oviposition 11:01 on S. r. nivalis, and oviposition 11:15 on underside of leaf of Polygonum (Bistorta) viviparum, both Uncompahgre Peak, Hinsdale Co. Colo., Aug. 3, 1979. Eggs laid singly. In the lab, small larvae eat holes in leaves of S. arctica, S. babylonica, and several other species of Colo. shrub willows, while older larvae eat entire leaves (see Scott 1982 for the complete life history). Ssp. acrocnema and harryi are obviously subspecies of improba because the hostplants are very similar, the habitats (tundra swales with dwarf-willow mats), low weak flight (perhaps slightly stronger in harryi), and most wing pattern and abdominal traits are the same (in overall appearance harryi resembles acrocnema rather than arctic improba). Larvae of the two ssp. are very similar, and pupae are similar also though the shape of some abdomen spots differs slightly (Scott 1986b). Thus the main hosts are prostrate Salix; but Polygonum viviparum is probably an occasional host if larvae eat it. Larvae hibernate as unfed stage 1 and unfed stage 4 during the two winters of its biennial life cycle (some stage 1 but no stage 4 larvae develop without diapause in the lab).

Boloria improba harryi F. Oviposition 10:00 on underside of small leaf of Salix arctica NW Mt. Chauvenet, Wind River Mts., Wyo., Aug. 10, 1983. S. arctica is 10 times as common as Salix reticulata nivalis in Wyo., perhaps because the alpine zone is wetter than in Colo. Eggs laid singly. In the lab, small larvae eat holes in leaves of S. arctica, Salix babylonica, and several other species of Colo. shrub willows, while older larvae eat entire leaves. Larvae hibernate as unfed stage 1 and unfed stage 4 during the two winters of its biennial life cycle (some stage 1 but no stage 4 larvae develop without diapause in the lab). Pupae were noted to lie horizontal in a nest of leaves and stems loosely silked together. MATURE LARVA has a middorsal brown-tan band (edged below by a few white wiggles), next a blackish-brown band (the BD2 scoli are on the lower part of this blackish band), next a bright-cream subdorsal line runs just below BD2 scoli, next a wide blackish-brown band includes BSD scoli on its lower edge, a tan line runs along lower edge of BSD scoli (in one larva a weak cream line runs rearward from top and from the bottom edges of BSD scoli on T2-3), area along spiracles and beneath larva dark-brown or brown with tan dots around hairs (the area along BL scoli sometimes has slightly more pale dots), T1 below the whitish subdorsal band is mainly blackish-brown down to the legs, the BD2, BSD, and BL scoli are orange with black needles and tan base, a whitish subventral BSV bump has ~12 black needles; head blackish-brown, a slightly-paler (brown) spot is on the top of each temple and a similar spot is on base of frontoclypeus of some larvae. PUPA has a more-distinct pattern when young than when older, a subdorsal yellowish line is on young pupa but is only on intersegmental membrane in older pupa, wings mostly dark-brown, A5-7 each has a middorsal anterior saddlehorn bump with a long black triangular spot angling posterolaterally from it, a grayish triangular area is behind bump between the two triangular spots, a day before emergence is blackish-brown all over, with the grayish triangular area faint, the subdorsal cream line limited to the 3 movable intersegmental membranes, all these movable intersegmental membranes brown, wings blackish-brown but inside of cells of outer half of wing paler (slightly-blackish-brown).

Boloria freija browni (Higgins). Oviposition 14:39 on Vaccinium cespitosum, oviposition 9:40 on dead grass blade near Erigeron ursinus seedling (larvae doubtfully eat this plant), oviposition 9:41 on Umbelliferae seedling with leaflets with minute dark-red mucronate tips (probably Conioselinum scopulorum, possibly Pseudocymopterus montanus or Ligusticum [filicinum var.] tenuifolium [larvae doubtfully eat this plant]), all three ovipositions near abundant V. cespitosum on lower slope at edge of Salix planifolia willow bog, larvae raised on V. cespitosum in the lab until diapause at about 4th stage, Caribou, Boulder

Colo., June 22, 1973. Oviposition 12:30, she landed on Vaccinium cespitosum twice then laid one egg on underside of tiny Kalmia (polifolia) microphylla leaf (K. microphylla very common 2 cm onward, V. cespitosum common 3 cm onward, Viola labradorica common 1 cm onward, Polygonum [Bistorta] viviparum 3 cm onward, Potentilla diversifolia 3 cm onward, Salix planifolia seedling 1 cm away), Loveland Pass, Summit Co. Colo., July 23, 1988. Vaccinium cespitosum is the probable host here, though based on lab feeding studies by Clyde Gillette (pers. comm.), Viola, Polygonum, and Potentilla are also suitable foods for larvae so may be occasional hostplants. Eggs laid singly, usually on low green plant leaves. Larvae diapause at about the 4th stage, presumably unfed 4th stage. Vaccinium cespitosum is certainly the main host in Colo.; adults are associated with V. cespitosum at the edge of bogs and on drier areas within willow bogs. B. freija is usually found on moist lower slopes at the edge of willow bogs or streams, in contrast to B. eunomia and B. frigga which only occur inside (throughout) willow bogs.

Speyeria. The Colo. Speyeria can be divided into "wetland" species (including nokomis, mormonia, and atlantis) which usually oviposit near green violets, and "dryland" species (including aphrodite, callippe, edwardsii, and presumably coronis) which oviposit near green violets if present, but at drier sites that lack late summer green violets they oviposit under shrubs etc. where the violets have dried up for the year and will not sprout from dormant roots until the following spring; the dryland species in general may have a longer physiological delay from female emergence to egg laying. (Four unstudied species occur in W Colo.: S. hydaspe (Bdv.) and egleis (Behr) occupy conifer-aspen forest and are presumably wetland species; S. cybele (Fab.) occupies the same habitat and shady oak/Amelanchier thickets and may be a wetland species, and S. zerene (Bdv.) occupies the same habitats as cybele and mesic sagebrush and is perhaps a dryland species.)

Speyeria aphrodite aphrodite (Fab.) (= "ethne" Hemm.). Oviposition 10:40 under Cercocarpus montanus shrub, E end South Table Mtn., Jefferson Co. Colo., Aug. 28, 1980. Oviposition 11:40 under C. montanus shrub on dead twig, and oviposition or preoviposition under three other C. montanus shrubs, Green Mtn., Jefferson Co. Colo., Aug. 17, 1978. Ovipositions 11:30 and 11:32 among grass in low spots 1.6 m from C. montanus shrubs, Green Mtn., Jefferson Co. Colo., Sept. 6, 1983. Oviposition 11:36 on underside of tiny twig in litter among various plants (no Viola seen), oviposition 11:58 on underside of dead leaf in litter under C. montanus shrub (no violets seen), ovipositions 12:09 and 12:10 on underside of dead twigs in litter under Rhus aromatica trilobata bush (no violets seen), all Green Mtn., Jefferson Co. Colo., Aug. 19, 1984. Oviposition 11:50 in litter (near grasses, Artemisia, Liatris, and Linaria, but no Viola seen), and oviposition 11:29 under hillside C. montanus bush (grasses and cactus nearby but no Viola), Green Mtn., Sept. 5, 1985. Two ovipositions 10:42 on dead stems & twigs in litter in 3 cm wide hollow of flat Carex probably pennsylvanica heliophila sward (some grasses and dead plants were nearby, but no Viola), Green Mtn., Sept. 7, 1985. Preoviposition by 2 females in shady 15 cm hollows among grass clumps on sloping flat, Green Mtn., Jefferson Co. Colo., Sept. 11, 1986. Oviposition 11:23 in shade on underside of horizontal stems in litter among Gutierrezia sarothrae, Thlaspi arvense, grass, and Artemisia ludoviciana, W Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 10, 1987. Oviposition 10:25 on underside of dead grass blade 5 cm from Viola adunca, oviposition 10:26 on underside of tiny twig 5 cm from V. adunca, oviposition 11:44 on underside of pine needle 10 cm from V. adunca, all Corwina Park, Jefferson Co. Colo., Aug. 17, 1984. Oviposition 12:52 on underside of dead grass blade in litter 20 cm from small V. adunca plant, oviposition 11:47 in litter with no violets near, Corwina Park, Aug. 27, 1984. Oviposition 11:05 on pine needle below V. adunca, O'Fallon Park, Jefferson Co. Colo., Aug. 12, 1985. At lower foothills localities (Green Mtn., South Table Mtn., Soda Lakes), no violets occurred near the eggs when the eggs were laid, but in the spring Viola nuttallii is very common under the shrubs (and is also common but patchy on open flat grassland where some eggs are laid) so is the presumed larval host. At localities above the lower foothills (Corwina & O'Fallon Parks) violets are green in late summer and females lay on or near them (mostly V. adunca evidently, rather than V. canadensis which grows along creeks and in shade). Thus females oviposit near green violets if present, but if dried up for the year (in the lower foothills) they usually oviposit under shrubs etc. where Viola nuttallii is likely to sprout the next spring. Females were seen mating as late as L Aug., but most mate in July-M Aug. and then delay laying eggs (reproductive diapause) until L Aug.-E Sep. in the foothills and adjacent plains of the Colo. Front Range, when they travel widely and oviposit. Unfed-1st-stage larvae hibernate.

Speyeria cybele charlottii (Barnes). Adults associated with Viola canadensis

ssp. or sp. rydbergii (ruquilosa) in Quercus gambelii understory, NE Hayden, Routt Co. Colo., July 6, 1989.

Speyeria nokomis nokomis (Edw.) (= nigrocaerulea W. & T. Cock.). Ovipositions 12:23, 13:30, 14:25, 14:30, 14:31 on dead grass and twigs near Viola sororia affinis (= nephrophylla), Sangre de Cristo Mts., New Mex., Aug-Sept. 1978. Ovipositions 11:40, 11:45, 13:00 on grass etc. next to V. s. affinis (reared to adults in lab on V. s. affinis, Chuska Mts., San Juan Co. New Mex., Sept. 7, 1977, Aug. 19, 1980. Because of the late-season flight, females do not seem to delay egg-laying. They oviposit near green violets. Scott & Mattoon (1982) give the life history. Unfed-1st-stage larvae hibernate.

Speyeria mormonia eurynome (Edw.). Oviposition 14:20 on a twig near the ground between Rumex densiflorus and Potentilla plattensis, no violets observed nearby, Keystone Gulch, Summit Co. Colo., Aug. 6-7-8, 1977. Oviposition 11:15 on Achillea lanulosa leaf 30 cm away from Potentilla sp., Salix sp., and ?Viola, Vail Pass, Summit Co. Colo., Aug. 22, 1977. Preoviposition 5 times in low spot near Vaccinium (perhaps searching for violets?), Loveland Pass, Summit Co. Colo., Aug. 5, 1985. Preoviposition or oviposition (no egg found) 10:16, she probed abdomen into litter next to Carex rupestris drummondiana & Geum (Acomastylis) rossii turbinata (Dryas octopetala hookeriana 3-100, Trifolium dasyphyllum 5, 45, Salix reticulata nivalis 7-100, Salix arctica petraea 2-15, Potentilla diversifolia 30, 50, Polygonum [Bistorta] viviparum 4, 7, 15, Artemisia scopulorum 12, 15, 30, 40, Castilleja occidentalis 50); this proves nothing, other than that females oviposit haphazardly; Loveland Pass, Clear Creek Co., Colo., July 19, 1989. By adult association, Viola labradorica is surely the main hostplant. Females seem to have little or no delay in egg-laying (reproductive diapause), though they tend to disperse when frosts come to the high mountains in late summer (I have found three females on the plains in L Aug.-E Sep.).

Speyeria callippe meadii (Edw.). Oviposition 13:00 under Cercocarpus montanus shrub on hill (Viola nuttallii was common under these same shrubs in spring 1979), Mt. Zion, Jefferson Co. Colo., July 11, 1978. Oviposition 12:50 on twig in shade beneath clump of Prunus (Padus) virginiana melanocarpa bushes, no violets seen, hilltop at Shingle Creek, Jefferson Co. Colo., July 23, 1984; V. nuttallii occurs at this site. Preoviposition 11:10 bent abdomen in litter under C. montanus bush, preoviposition 11:11 bent abdomen in litter under 25 cm tall Rosa bush, oviposition 11:20 3 cream eggs laid in dead litter in shade under combined Helianthus pumilus/Toxicodendron rydbergii bush on slope just S of hilltop, Mt. Zion, Jefferson Co. Colo., July 11, 1988; V. nuttallii must be the hostplant here. Females flutter around bushes and crawl into shady hollows, where they probe the abdomen down and forward or straight down to lay eggs. Viola nuttallii is surely the major host in the foothills, though other Viola may be used at higher altitude. Females have little or no reproductive diapause, and die before late summer. Unfed-1st-stage larvae hibernate.

Speyeria atlantis dorothea Moeck. Oviposition on Viola sororia affinis (= nephrophylla) stem, Chuska Mts., San Juan Co. New Mex., Aug. 19, 1980.

Speyeria atlantis hesperis (Edw.). Six eggs laid 10:30-11:02, 11:10, and 12:20 on debris near Viola canadensis (W) var. scopulorum, and three eggs laid 11:00, 11:10, 11:30 near Viola adunca (W), both at Tinytown, Jefferson Co. Colo., July 30, 1978. Ovipositions 10:04 & 10:06 on underside of pine needles near V. adunca, oviposition 10:58 on underside of grass blade near V. adunca, oviposition 12:01 near V. adunca, oviposition 12:55 on debris near V. c. var. scopulorum, all O'Fallon Park, Jefferson Co. Colo., Aug. 13, 1984. Oviposition 10:55 on underside of pine needle 10 cm from V. adunca (she landed on V. adunca then crawled away to lay), oviposition 12:25 on underside of dead grass blade near V. adunca, O'Fallon Park, Aug. 16, 1984. Oviposition 10:50 on underside of twig in litter near V. adunca, Corwina Park, Jefferson Co. Colo., Aug. 17, 1984. Adults associated with V. c. var. scopulorum, 3.5 mi. W Evergreen, Jefferson Co. Colo., Aug. 6, 1987. V. adunca and V. c. var. scopulorum seem to be the main hostplants in the foothills of the Colo. Front Range; adults are associated with both species at Critchell, Jefferson Co. Colo., 1978-1985, and with V. c. var. scopulorum at Red Rocks, Jefferson Co. Colo., Aug. 1, 1978 and at Devil's Head Cgd., Douglas Co. Colo., July 31, 1978. Eggs laid by females from Cherry Gulch, Tinytown, Critchell, and Corwina Park, all Jefferson Co. Colo., and from Mt. Judge, Clear Creek Co. Colo., 1984-1985, were reared to adults in lab on Viola sororia affinis (= nephrophylla) (Scott 1988a). Females seem to have little delay in egg laying (reproductive diapause), and some females emerge and were seen mating as late as L Aug. Dispersal is weaker than in some aphrodite and mormonia females. Females always oviposit near green violets, mostly V. canadensis and V. adunca in shade of trees (in gulches and N-facing slopes in the foothills); they occur on N-facing slopes and along creeks, so dryland violets

are not hostplants. Unfed-1st-stage larvae hibernate. Egg cream, turning mottled reddish-brown. Scott (1988a) describes early stages. 71

Speyeria atlantis atlantis (Edw.) (= electa [Edw.]). Mature larva (reared to adult) found resting on litter in low spot near creek, 50-150 cm away were Viola sororia affinis (= nephrophylla) plants, N fork Clear Creek, Gilpin Co. Colo., June 14, 1989. Preoviposition V. s. affinis (= nephrophylla), N Fork Clear Creek, Gilpin Co. Colo., July 16, 1988. V. canadensis and V. adunca are probably also hosts. Scott (1988a) describes early stages.

Speyeria atlantis ratonensis Scott. Adults assoc. Viola canadensis var. scopulorum, Raton Mesa, Las Animas Co. Colo., July 28-29, 1985.

Speyeria coronis halcyone (Edw.). Adults can be found from late May until mid September; females diapause and evidently oviposit in late summer. By adult association, Viola nuttallii must be a major host.

Speyeria edwardsii (Reak.). Oviposition 9:40 2 eggs on underside of narrow dead stems in litter in shady 4 cm wide nook of grassland (various grasses nearby but no Viola), and oviposition 9:59 on underside of dead stem in litter in 5 cm wide hollow of grassland (various grasses, Verbena, and Grindelia were nearby, but no Viola), both flat grassland at Green Mtn., Jefferson Co. Colo., Sept. 5, 1985; Viola nuttallii occurs on the flat grassland where these eggs were laid, but is somewhat patchy in occurrence. Oviposition 13:03 on crook of tiny twig in litter (2 cm from Bouteloua gracilis, 2 cm from Gutierrezia sarothrae, 2 cm from dead Thlaspi arvense, many T. arvense tiny seedlings nearby), this spot was a 15-cm-wide area of slightly lower vegetation on a shaley gentle slope with no Viola in sight (and was not a shady nook under a shrub), Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 9, 1987. Oviposition 11:25 bent abdomen in litter then flew 3 m and laid egg under dead 1-mm-wide twig (no Viola seen though Viola nuttallii is present at this site; Linum lewisii 5, 10, 15, 15, 25, etc., Melilotus officinalis 5, 10, 35, etc., Aster ericoides 1, 3, 30, Gutierrezia sarothrae 10, 15, Carduus nutans 7, 30-100, Grindelia 25, Yucca 80, 100, Chrysothamnus nauseosus 3, 3); perhaps Linum is a host?; N Bear Creek Res., Jefferson Co. Colo., Sept. 9, 1991. Preoviposition 11:15 on flat she landed explored ground between grass ~20 times, Green Mtn., Jefferson Co. Colo., Sept. 17, 1991. Viola nuttallii must be the hostplant at these sites; it appears only in spring and drops its leaves in early summer. Females evidently diapause and oviposit in late summer. Unfed-1st-stage larvae hibernate. Egg cream, developing numerous small reddish spots so overall color is reddish-purplish-cream. 1ST-STAGE LARVA dull pale-orangish-yellow, seta bases brown, suranal plate and collar blackish; head black.

Euptoieta claudia (Cram.). Ovipositions at 8:08, 8:12, 8:20, 8:25, and one larva found on Linum (Mesynium) australe (W), the larva raised to adult on Viola sororia affinis (= nephrophylla), 1 mi. E Arroyo del Agua, Rio Arriba Co. New Mex., June 19, 1978. Oviposition 8:56 on L. australe, 2.7 mi. up Coyote Can. road, Rio Arriba Co. New Mex., June 19, 1978. Ovipositions 13:58, 14:02, 14:07 on side of stems near tip of seedlings (8-10 cm tall) of Linum (Adenolinum) lewisii, females did not even land on flowering L. lewisii, Bandimere Speedway, Jefferson Co. Colo., Aug. 10, 1984. Oviposition 13:11 on underside of leaf near end of branch of L. lewisii (W), W end South Table Mtn., Jefferson Co. Colo., Oct 5, 1987. Oviposition 12:40 leaf of L. lewisii 15-cm seedling, Tinytown, Jefferson Co. Colo., July 3, 1991. Oviposition 14:53 (2 eggs found within 1 cm--perhaps one was laid earlier) L. lewisii, Tinytown, Jefferson Co. Colo., July 4, 1991. Preoviposition 11:20 near L. lewisii, Lookout Mtn., Jefferson Co. Colo., May 30, 1988. Ovipositions 12:39 on sepal of flower bud, 12:42 & 12:48 on stem, 12:51 on leaf, 13:00 on leaflet in inflorescence, 13:02 on inflorescence, 12:55 on stem of inflorescence, all on L. lewisii; oviposition 12:43 on Poa nr. agassizensis leaf blade 8 cm from stem of L. lewisii, preoviposition 12:45 grass under L. lewisii, oviposition 12:57 dead plant stem beside L. lewisii, oviposition 13:01 on Agropyron [Pascopyrum] smithii leaf top 10 cm from Comandra umbellata (not a host); Tinytown, Jefferson Co. Colo., June 2, 1992. Oviposition 12:04 lower leaf, ovip. 12:37 10-cm-long sprout at plant base, both on Linum lewisii, ovipositing female landed on Sedum lanceolatum flowers 7x and plants 4x but did not oviposit; Tinytown, Jefferson Co. Colo., June 17, 1992. Preoviposition, she ignored Carex pennsylvanica heliophila and Comandra and old Sedum lanceolatum, Crawford Gulch, Jefferson Co. Colo., June 14, 1992. Oviposition 13:30 on underside of inflorescence peduncle of yellow Linum (Mesynium) sulcatum, E of Renville County Park, Renville Co. Minn., July 13, 1986. Oviposition 12:28, 12:29 on undersides of Viola nuttallii leaves near base, Lookout Mtn., Jefferson Co. Colo., June 5, 1991. Larva found on and raised on Viola tricolor var. hortensis ("pansy"), Lakewood, Jefferson Co. Colo., 1964. Oviposition 12:50 on underside of leaf of V. tricolor var. tricolor ("Johnny Jump Up", has narrow leaves with basal fingerlike extensions),

2 mi. NE Conger, Freeborn Co., Minn., June 18, 1986. Preoviposition on V. t. var. tricolor, Lakewood, Jefferson Co. Colo., June 12, 1987. Six eggs laid 10:50-11:25 on leaves and stems of Hybanthus verticillatus and one laid on a Thlaspi arvense plant nearby (T. arvense is undoubtedly not a larval food), E end South Table Mtn., Jefferson Co. Colo., May 27, 1980. Oviposition 11:40 on underside of leaf of H. verticillatus, another egg found on sepal of same plant, and 4th stage larva found on Gaura sp. (not a hostplant) beside H. verticillatus, Cherry Gulch, Jefferson Co. Colo., July 7, 1984. Ovipositions 10:11, 10:17, on leaf undersides of two H. verticillatus plants, Green Mtn., Jefferson Co. Colo., June 3, 1986. Oviposition 14:50, 14:52 on base of stem and on leaf top at base of H. verticillatus, Green Mtn., Jefferson Co. Colo., May 27, 1991. Oviposition 10:45 under H. verticillatus leaf, S Midway, Pueblo Co., Colo., May 6, 1992. Oviposition 10:45 H. verticillatus leaf, S Midway, Pueblo Co. Colo., May 6, 1992. Oviposition 11:00 on underside of dead grass blade next to touching Anemone cylindrica (W)(Ranunculaceae)(it is not known whether larvae can eat this plant, but they possibly can), NE Holland, Pipestone Co. Minn., July 12, 1986. HOSTPLANTS: Evidently semipolyphagous on certain fresh green low herbs, which may share some now-undiscovered chemical peculiarity. In Colo. L. lewisii and H. verticillatus seem to be the commonest hosts. Because females refuse to oviposit on Sedum lanceolatum in nature and lab larvae refused to eat it even when starved, Sedum cannot be a host (Theodore Mead recorded it as used frequently at Fairplay Colo. in July--a plant misidentification evidently but of what plant?) so should be eliminated from the hostplant list. Egg yellowish-cream. 1ST-STAGE-LARVA orangish-yellow, front of body with purplish-tan tinge, pronotum brown; head black.

LYCAENIDAE Riodininae

Melanis pronostriqa (identification based on plates in A. Seitz' Macrolepidoptera of the World, vol. 5). The hairy larvae were reared from leaves of Samanea saman (adults and larvae common on this tree), Puerto Asis, Colombia, Aug. 1976, and males patrol around the canopy of this host (and about nearby tops of buildings) from about 17:00 to dusk to seek females.

Apodemia mormo mormo (Felder & Felder). Adult association records are useful in this species because adults are always highly restricted to the larval hostplant Eriogonum. Adults assoc. Eriogonum leptocladon var. ramosissimum, dunes N Rock Point Trading Post, Apache Co. Ariz., Aug. 19, 1980. Adults assoc. Eriogonum microthecum (W), jct. Hwys. 12 and 410, Yakima Co. Wash., Sept. 9, 1973. Adults assoc. E. microthecum var. foliosum (R), Hwy 550 Animas River valley 7 mi. N New Mex. line, La Plata Co. Colo., Aug. 27, 1977. Adults assoc. E. m. var. foliosum (R), Horsehead Spring, San Juan Co. Utah, Sept. 4, 1977. Adults assoc. E. lonchophyllum var. lonchophyllum (R), W of Allison, La Plata Co. Colo., Aug. 28, 1977. Adults assoc. E. corymbosum var. velutinum (R), E Aztec, San Juan Co. New Mex., Aug. 27, 1977. Adults assoc. E. corymbosum var. orbiculatum (R), Unaweep Can., NE Gateway, Mesa Co. Colo., Aug. 23, 1977.

Apodemia mormo mejicanus (Behr). Oviposition Eriogonum jamesii var. jamesii, SW Trout Creek Pass, Chaffee Co. Colo., Aug. 15, 1973. Oviposition 11:22 E. j. var. jamesii, just NE Security, El Paso Co. Colo., Aug. 8, 1972. Adults associated with E. j. var. jamesii, Rio Grande Wild Area, Taos Co. New Mexico, Aug. 17, 1986.

Apodemia mormo near dialeuca Opler & Powell. Adults associated with Eriogonum wrightii var. wrightii (det James L. Reveal), 3 mi. W. Alma, Catron Co. New Mex., Aug. 9, 1986.

Apodemia nais nais (Edw.). Oviposition 14:23 on leaf just below inflorescence of Ceanothus fendleri in nature; in lab 18 eggs laid on leaves, 3 on twigs near leaves; near Smith Creek Cgd., June 28, 1971. Oviposition 12:10 on a lower branch of C. fendleri, near Smith Creek Cgd., Custer Co. Colo., July 5, 1973. Oviposition 9:00 on top of leaf next to inflorescence of C. fendleri, Mt. Zion, Jefferson Co. Colo., July 3, 1980. Three females from Mt. Zion, Jefferson Co. Colo., July 6 & 11, 1977, were placed in a plastic box with C. fendleri and Prunus (Padus) virginiana melanocarpa, and 64 eggs were laid on C. fendleri flowers, 21 on C. fendleri leaves, none on P. v. melanocarpa; larvae were raised on C. fendleri until they hibernated half grown. Edwards (1868-1897) raised Arizona nais on Prunus, and Kendall (1976) reported Prunus as the host of A. nais chisosensis F. However, based on the above data and adult associations, only Ceanothus is used in Colo. Larvae live in a nest of leaves silked together.

Hypaurotis crysalus crysalus (Edw.). Ovipositions 16:10 and 16:45 in crevices of terminal buds and ends of twigs of Quercus gambelii, Lake Creek Cgd., Custer Co. Colo., Aug. 1970. Egg pale greenish, turning brown after about a week. Eggs hibernate. Scott (1974d) reports ecology, behavior, and movements.

Hypaurotis crysalus citima (H. Edw.). Adults associated with Quercus gambelii throughout W Colo.

Lycaenini

Lycaena phlaeas polaris Cour. (=arctodon Ferr.). Adults assoc. Oxyria digyna at several sites in alpine zone of Wind River Mts., Fremont Co. Wyo., Aug. 11-14, 1983, where they occupy nooks in vegetated rockslides.

Lycaena cupreus snowi (Edw.). Oviposition 11:00 on rock next to Oxyria digyna inflorescence, Hermit Pass, Custer Co. Colo., Aug. 1, 1971. Preoviposition 12:15 O. digyna, Loveland Pass, Summit Co. Colo., July 22, 1988. Pupa with hole in abdomen found on underside of rock within several m of O. digyna, Loveland Pass, Summit Co. Colo., July 26, 1989. Ovipositions 10:39, 10:40, she landed on rock almost touching O. digyna and laid 2 eggs 2 cm apart on rock just below rock overhang (she never landed on plant so must have recognized host visually or olfactorily); ~7 eggs and ~6 eggshells found on rocks (just below the upper edge of rock or on the side of rock) that almost touch O. digyna; Loveland Pass, Summit Co. Colo., Aug. 7, 1990. Adults of ssp. snowi are associated with O. digyna in nooks of vegetated rockslides or cirques throughout alpine Colorado. In the alpine zone of Wyo.-Mont. this habitat is occupied by L. phlaeas polaris also associated with O. digyna. In N Utah-Wyo.-Mont. L. cupreus artemisia Scott occurs at lower altitude in Canadian-Hudsonian Zone sagebrush and woods openings, where Rumex or Polygonum must be the host. Larvae (from eggs laid by females from Loveland Pass, Summit Co. Colo., 1984, 1990) ate Rumex in lab, and larvae quit feeding when half-grown or somewhat larger, evidently indicating diapause (probably biennial, the two diapause stages uncertain). Early stages from Loveland Pass: EGG whitish-tan, turning white, camouflaged on the mottled rock (some lichen bumps resemble the eggs also). FIRST-STAGE LARVA cream-yellow, with long dark-brown setae, a brownish subdorsal spot on each segment, pronotum brown. 2ND-STAGE LARVA tan due to brown hairs. ~3RD-STAGE LARVA olive-green, heart-band brown edged by tan, lateral ridge tan, three oblique slightly-paler dashes (the uppermost palest) on each segment between top and side. NEARLY-MATURE LARVA dark-green or yellow-green, heart-band brownish-green (edged by yellowish-green on paler larvae), 2 faint narrow pale-green oblique dorsolateral dashes, lateral ridge slightly yellow-green on paler larvae, these markings all weak. PUPA light brown, a middorsal brown band on T1-3 (weak on A4), subdorsal brown areas on T2-3, a subdorsal brown dot on each abdomen segment, a brown spot above fw base; length 11 mm.

Lycaena thoe (G.-M.) (=hyllus [Cram.]). Oviposition 13:03 on dead leaf, oviposition 13:10 on dead leaf, oviposition 12:30 on dead tip of live leaf, all on middle or lower leaves of Polygonum coccineum (=P. amphibium var. emersum) (W) plants growing in shallow water; oviposition 12:55 on dead leaf at base of Rumex crispus; Wheat Ridge, Jefferson Co. Colo., Aug. 14, 1977. Oviposition 12:12, she landed on a totally-dead Rumex crispus inflorescence 11:59, flew 4 times and landed on another dead R. crispus inflor. & crawled down its stem 10 cm then fluttered down 5 cm then crawled down 10 cm & crawled & bent abdomen in litter 1 cm away from stem (no egg found) then crawled 7 cm away from stem and laid egg 12:12 under 1-mm-wide dead grass stem in litter, Wheatridge, Jefferson Co. Colo., Aug. 17, 1991. Adults common to uncommon in pure stand of P. coccineum at lake edge, Barr Lake, Adams Co. Colo., Aug. 29, 1974, to Aug. 30, 1991. Assoc. P. coccineum, Upper Twin Lake, Freeborn Co. Minn., June 26, 1985. Preoviposition 12:15 near R. crispus along canal, Barr Lake, Adams Co. Colo., Sept. 25, 1989. Females oviposit in litter at the host base except when the hosts grow in water, when eggs are placed higher up. Eggs hibernate. Egg dull greenish when laid, after a few hours turning white.

Lycaena helloides helloides (Bdv.). Egg found on dead leaf below plant (identical to eggs dissected from females) of Rumex triangulivalvis, E of Moffat, Saguache Co. Colo., Aug. 29, 1977. Oviposition on lower branch of Rumex maritimus fueginus (W), lake at Kipling and W. Jewell Sts., Lakewood, Jefferson Co. Colo., Aug. 17, 1978. Oviposition 13:00 on dead lower leaf of Polygonum coccineum (=P. amphibium var. emersum), Barr Lake, Adams Co. Colo., Aug. 29, 1984. 1 egg found on underside of dead leaf of litter under Rumex crispus; 1 egg on underside of dead leaf, 4 eggs on underside of dead leaf, 1 egg on

74 underside of dead leaf, 3 eggs on underside of dead leaf, 1 egg on underside of dead leaf, all five leaves in litter under five Rumex triangulivalvis plants; 2 eggs on underside of dead leaf 30 cm from top of plant and 60 cm above ground of Polygonum pensylvanicum; P. coccineum is the commonest known host here, millions growing around the lake just below high water level, and adults are common on it here every year; all Barr Lake, Adams Co. Colo., Sept. 8, 1987. Preoviposition 12:40 P. coccineum, she crawls down stem, ~60 adults assoc. P. coccineum, Barr Lake, Adams Co. Colo., Oct. 8, 1988. Two ovipositions 9:52, 9:52 on top of green leaf near top of plant, another egg found on top of green leaf, and 20 2nd-4th stage larvae and 1 prepupa found on green leaves (usually near leaf base, sometimes on stems) near top of plant, all on P. coccineum (W); females oviposit near top of plants at this site evidently because there was no litter where the plants grew in a slough, and the hosts stand in water after rains; larvae eat holes in leaves or eat leaf tip, pupae are attached by both cremaster and silk girdle; Salida, Chaffee Co. Colo., July 30, 1985. Adults associated with P. coccineum; Wheatridge, Jefferson Co. Colo., July 14, 1990. Adults associated with Polygonum probably coccineum, Battle Mountain, Lander Co. Nevada, Aug. 5, 1974. Adults associated with P. coccineum, Smith Lake, Sheridan Co. Neb., July 17, 1986. Adults associated with P. coccineum, Wheatridge, Jefferson Co. Colo., July 13, 15, 1988. Three yearly flights occur on the plains. Eggs hibernate. Early stages from Salida: EGG white. MATURE LARVA (half-grown larva similar) yellowish-green, with cream bases of the numerous pink setae, a middorsal green band edged by yellow-green, a subdorsal greenish-yellow sinuous line (dorsally convex on each segment) edged by tan-green, a very faint green sinuous band above spiracles, a lateral greenish-cream line, subventral & midventral areas translucent bluish-green; head dark brown. PUPA dark red, creamy-red, reddish-tan, light-reddish-tan, or reddish-yellow in different individuals, all have a middorsal tan to blackish band (weakest on top of T2), a subdorsal tan to blackish band (these bands blackish in the darker pupae), wing veins pale, blackish mottling above wing on T3-A1, the blackish mottling spread over most of pupa in two reddish-tan pupae (the wings sooty-brown in the darkest pupa), spiracles (strangely) on hills, cream, pupa attached by silk girdle and presumably cremaster.

Lycaena helloides florus (Edw.) (I treat castro Reak. as a synonym of helloides because most syntypes resemble very-orange helloides, castro lacks a specific type locality, and "first revisers" had treated it as a synonym of helloides; at best, castro is a helloides/florus intergrade population closer to helloides, and therefore is a synonym of helloides). Egg (identical to eggs dissected from female) found on trash at base of Rumex densiflorus (W), Keystone Gulch, Summit Co. Colo., Aug. 6-7-8, 1977. Egg (identical to eggs dissected from female) found at base of stem of Rumex triangulivalvis, Fall River Reservoir, Clear Creek Co. Colo., Aug. 10, 1977. Oviposition 13:12 on dirt at base of Rumex acetosella (= Acetosella vulgaris), oviposition 13:08 on tiny plant next to both R. acetosella and Polygonum arenastrum ("aviculare"), oviposition 13:35 on base of stem of P. arenastrum, all Toll Ranch, Gilpin Co. Colo., July 28, 1977. Oviposition 10:11 on grass blade next to Polygonum douglasii, Jim Creek Cgd., Grand Co. Colo., Aug. 9, 1977. Preovipositions 10:30, 11:10, 11:10 on P. douglasii, then oviposited 11:15 3 cm up on dead Poa pratensis leaf under canopy of Artemisia tridentata (P. douglasii common all around from 2-100 cm), Fraser, Grand Co., Colo., Aug. 5, 1991. R. acetosella, P. arenastrum, and P. douglasii are small plants usually growing on dirt-mound gopher diggings on deep soil of valley bottom forest clearings, while R. densiflorus and triangulivalvis are large. This ecotype/subspecies occurs as low as the Canadian Zone at Critchell 7760' in Jefferson Co. Colo. (to compare with the data of Scott 1979, the number of orange uph lunules on Critchell males is 0-1, 1-3, 2-13, 3-15, 4-8, 5-0; and the amount of upf orange on females is A [none or a trace]-3, B [only postmedian spots]-7, C [postmedian band and some median spots orange]-6, D [postmedian band solid orange and median part of wing mostly orange]-6, E [mostly orange]-2, F [completely orange]-0; these frequencies have remained stable from 1978 to 1985). One generation per year; wherever in Colo. that temperature limits the species to one yearly flight, the florus ecotype occurs, in which adults vary in appearance from very dark to resembling helloides (Scott 1979); where two or three flights can occur, the helloides ecotype flies. The florus ecotype has nothing to do with Lycaena dorcas (Kirby), which eats Pentaptylloides floribunda=Potentilla fruticosa (Scott 1979). Eggs hibernate. EGG greenish-white when laid, turning white.

Lycaena heteronea heteronea (Bdv.). One egg on umbel-subtending bract of E. subalpinum (= "E. umbellatum var. major"; E. subalpinum and E. umbellatum are sympatric and do not interbreed throughout much of Colo.), Toll Ranch, Gilpin Co. Colo., July 30, 1977. Mature larva found dead (attacked by ant) on

subalpinum; SSW Hot Sulfur Springs, Grand Co. Colo., July 11, 1990. Adults associated with Eriogonum umbellatum var. porteri, Silver Creek, Hinsdale Co., Colo., July 18, 1988, and Tennessee Pass, Lake Co., Colo., Aug. 15, 1971, Aug. 9, 1972. MATURE LARVA green, with darker-green middorsal band edged by weak yellow-green dashes, three oblique weak yellow-green dashes on each segment, a weak lateral yellow-green ridge, with dendritic setae near A8 spiracle.

Lycaena heteronea gravenotata (Klots). Oviposition 7:35 and 30 eggs found at the base of (generally beneath) umbel-subtending bracts of Eriogonum umbellatum var. umbellatum, Red Rocks, Jefferson Co. Colo., July 14, 1972. Five eggs on bracts below E. u. var. umbellatum umbels, SE Blackhawk, Gilpin Co. Colo., July 24, 1973. Six eggs on bracts below E. u. var. umbellatum umbels, Mt. Zion, Jefferson Co. Colo., July 11, 1977. 3 eggs found at base of bracts beneath umbels of E. u. var. umbellatum, Mt. Zion, Jefferson Co. Colo., July 6, 1988. Egg found on underside of umbel-subtending E. u. var. umbellatum bract; Lookout Mtn., Jefferson Co. Colo., Aug. 15, 1990. Oviposition Eriogonum jamesii var. jamesii, SW Trout Creek Pass, Chaffee Co. Colo., Aug. 1973; adults are associated with E. j. var. jamesii throughout southern Colorado (Chaffee, Fremont, Custer, Saguache Cos. Colo.). Six eggs on bracts at base of umbels of E. jamesii var. flavescens, Mt. Zion, Jefferson Co. Colo., July 11, 1977. In contrast to other Lycaena which crawl down the host stem and lay eggs on stems or litter at the hostplant base, heteronea lays on the bracts subtending the umbel (though in the Calif. ssp. clara eggs are supposedly laid on leaves). Eggs hibernate. Adults are widely distributed on hillsides etc., in contrast to the previous Lycaena which concentrate in valley bottoms.

Lycaena rubidus rubidus (Behr) (includes form sirius [Edw.]). Ovipositions 12:30 (1 egg on chip of wood), 12:30 (1 egg on 3 cm tall plant similar to Thalictrum) within 10 cm of Rumex trianquilivalvis (W), Toll Ranch, Gilpin Co. Colo., July 28, 1977. Oviposition 11:30 on trash at base, oviposition 11:50 on twig at base, both on R. trianquilivalvis (W), Toll Ranch, July 30, 1977. Oviposition 12:20 on twig at base, oviposition 12:30 on dead leaf at base, both on R. trianquilivalvis (W), West Chicago Creek, Clear Creek Co. Colo., July 31, 1977. Oviposition 12:21 on underside of litter under R. trianquilivalvis, and at 12:40 a female flew up from underneath Rumex crispus (no egg found), N Fork Clear Creek, Gilpin Co. Colo., Aug. 10, 1987. Ovipositions 11:05, 11:09, 11:14, female crawled 20 cm down stem of small R. trianquilivalvis and placed eggs near plant base beneath narrow stems in litter, Silverton, San Juan Co., Colo. Aug. 10, 1991. Two eggs laid 12:30 on dirt at base, and 45 eggs found on trash at base (eggs identical to eggs dissected from females), all at base of Rumex densiflorus (W), Keystone Gulch, Summit Co. Colo., Aug. 6-7-8, 1977. Egg found on twig at base of Rumex aquaticus occidentalis (W), E Idaho Springs, Clear Creek Co. Colo., Aug. 10, 1977. Five eggs found at base of R. a. occidentalis (W), N of Idledale, Jefferson Co. Colo., Aug. 21, 1977. Oviposition or preovip. 12:10 she probed many times with abdomen and 2 eggs found under plant, 4 eggs found under nearby plant, all on R. a. occidentalis, Fraser, Grand Co., Colo., Aug. 5, 1991. Egg found at base of R. crispus, N of Idledale, Jefferson Co. Colo., Aug. 21, 1977 (eggs from last three sites identical to eggs dissected from females--L. xanthoides and L. helloides eggs can be easily separated from those of rubidus). Oviposition, female crawled down stems of Polygonum douglasii 3X at 12:14, basked, then crawled down P. douglasii and nearby plants, crawled around in litter and at 12:30 laid up to 4 eggs in litter (I found only 2 of them, 1 cm from P. douglasii base); 2 preovipositions 11:55 P. douglasii; Fraser, Grand Co. Colo., Aug. 1, 1990. Elsewhere in Colo., adults are associated with Rumex venosus on the northeastern plains in Weld Co., with Polygonum coccineum (= P. amphibium var. emersum) at Elbert, Elbert Co., July 3, 1978, and with Rumex aquaticus occidentalis, densiflorus, and utahensis at various mountain sites. The typical habitat is near a creek. The large-leaved Polygonaceae may be preferred to the small-leaved, but both are chosen without much preference. Eggs hibernate. Egg greenish-white when laid, becoming white.

Lycaena xanthoides dione Scud. Oviposition two eggs 12:30 on debris at base of Rumex trianquilivalvis, Red Rocks, Jefferson Co. Colo., July 12, 1973. Two eggs (compared to eggs dissected from female) found at base of Rumex aquaticus occidentalis (W); three eggs (compared to eggs dissected from female) found at base of Rumex crispus; N of Idledale, Jefferson Co. Colo., Aug. 21, 1977. Males and female seen in meadow with 3-4 Rumex crispus and ~200 Polygonum coccineum (= P. amphibium var. emersum); Wheatridge, Jefferson Co. Colo., July 14, Aug. 6, 1990. Adults do not occur on the vast P. coccineum stands at Barr Lake, Adams Co., Colo., that are submerged in spring, so it may not be a host, or the eggs may not survive submergence. Eggs hibernate. Egg white (no doubt greenish-white when laid).

Lycaena xanthoides editha (Mead) (perhaps a species L. editha? (=montana [Field])). Oviposition 9:50 three eggs on trash next to Rumex acetosella (=Acetosella vulgaris), Toll Ranch, Gilpin Co. Colo., July 27, 1977. Oviposition 12:07 on dead leaf next to R. acetosella, Jim Creek, Grand Co. Colo., Aug. 9, 1977. Oviposition 11:30, she landed on R. acetosella ~2 cm from Polygonum douglasii and crawled down to ground and laid egg on litter bit near base of 3-cm-tall Fragaria virginiana glauca (egg was 5 mm from fairly large R. acetosella plant without inflorescence, and 2 cm, 4, 7, 8, 9, 9 cm from other R. acetosella, egg 6 mm from mostly-eaten P. douglasii, and 4 cm, 6, 7, 8, 11 cm from other P. douglasii); oviposition 11:31, the same female then laid an egg on litter bit at base of sedge (egg 2, 4, 4, 8, 10, 14 cm from R. acetosella, 4, 6, 7, 7, 7, 10 cm from P. douglasii); both eggs were 10-15 cm from flowering R. acetosella and 10-15 cm from flowering P. douglasii; oviposition 11:50, she landed on R. acetosella and crawled down plant 2X and then crawled 9 cm toward base of small sagebrush and laid 3 eggs on litter about 3-4 cm from each other (1 on a 3-cm-long twig, 1 on a 0.3-mm X 2-mm twig, 1 on seedling Fragaria virginiana glauca stem) among 3 P. douglasii plants (5, 6, 6, 7, 8, 10, 15 cm from P. douglasii, 9, 10, 10 cm from R. acetosella); Fraser, Grand Co. Colo., Aug. 2, 1990. Female seen at Polygonum douglasii patch, Fraser, Grand Co. Colo., Aug. 1, 1990. The small ssp. editha would seem to be adapted to small hostplants, the large ssp. dione and xanthoides to the larger Rumex. Yet both R. acetosella and P. douglasii are hostplants, and females definitely seem to prefer the introduced R. acetosella to the native P. douglasii, evidently because the former has much larger leaves. Eggs hibernate. Egg greenish-white when laid, becoming white.

Lycaena arota virginiensis (Edw.). 19 ovipositions (9 on rough bark of the thicker branches, 12 on sides of smooth twigs of the thinner branches, 2 on dead leaves of two different dicotyledons beneath Ribes leptanthum) all day at 9:12, 9:24, 9:27, 9:34, 9:49, 9:59, 10:00, 10:50, 10:55, 11:00, 11:08, 11:15, 11:21, 11:24, 11:34, 11:36, 11:40, 11:40, 14:24 on R. leptanthum (6), Spring Creek, Fremont Co. Colo., July 30 to Aug. 8, 1969. Oviposition R. leptanthum (6), Little Fountain Creek, El Paso Co. Colo., Aug. 4, 1971. Oviposition on R. leptanthum twig (previously misidentified as Ribes montigenum [6]; there are no valid records of R. montigenum for L. arota, thus this host in Scott 1974c, which reports ecology and behavior, is misidentified), Williams Can., El Paso Co. Colo., Aug. 11, 1971. Adults associated with R. leptanthum, Reynolds Park, Jefferson Co. Colo., Aug. 25, 1990. Adults associated with R. leptanthum, Roxborough Park, Jefferson Co. Colo., Aug. 14, 1991. Adults (rare) assoc. Ribes inerme, Tinytown, Jefferson Co. Colo. Females often crawl and flutter down among the hostplant stems well within the plant, where they oviposit; they fly into the center of the bush to oviposit just as often as they fly onto the outer branches, and may spend an hour or more in one plant, alternating oviposition about every five minutes, basking, "hindwing rubbing", and resting. Eggs hibernate.

Eumaeini

Phaeostrymon alcestis (Edw.). Adults associated with Sapindus saponaria var. drummondii, Cottonwood Crk., Baca Co. Colo., July 3-4, 1973.

Satyrrium (Harkenclenus) titus titus (Fab.). Female landed on leaf of Prunus americana shrub and crawled down stem to ground and oviposited in litter 8 cm from stem, Chimney Gulch, Jefferson Co. Colo., July 10, 1978. About 100 adults seen in a 10 m X 10 m area on pure stand of Prunus (Padus) virginiana melanocarpa growing on sand, just E of Sand Dunes, Medano Creek, Alamosa Co. Colo., Aug. 1, 1970. Female landed on leaf at tip of 40-cm.-tall seedling of P. v. melanocarpa (Prunus [Cerasus] pennsylvanica was 20 m away also, but seedling was probably P. v. melanocarpa) and then walked down stem to base and laid 5 eggs in cluster on rock at 10:00, the eggs merely glued on (not in a copious mass of glue), Tucker Gulch, Jefferson Co. Colo., July 30, 1987. Female rested on young P. v. melanocarpa then flew to another, Tinytown, Jefferson Co. Colo., Sept. 4, 1991. The usual larval host is P. v. melanocarpa, based on adult association. The habit of crawling down the host stem to oviposit on trash at the base occurs also in Satyrrium fuliginosum, most Lycaena, and Plebejus melissa. Eggs hibernate.

Satyrrium (Fixsenia) favonius autolytus (Edw.) (=violae S. & T.). Adults associated with Quercus gambelii (normal-leaf var. gambelii and shallowly-lobed-leaf var. undulata which may be a hybrid between Q. gambelii and Quercus grisea), Cottonwood Creek, Baca Co. Colo., July 3, 1973.

Satyrrium californica (Edw.). Oviposition 10:30 3 eggs laid in glued cluster at base of leaf petiole of Prunus (Padus) virginiana melanocarpa; oviposition

10:00 4 eggs glued in crevice at joint of stem, oviposition 10:15 2 eggs glued in depressed scar on twig, oviposition 10:45 3 eggs glued in hole in twig, all on Cercocarpus montanus; Lookout Mtn., Jefferson Co. Colo., July 8, 1977. Two females crawled over twigs of C. montanus for 90 minutes searching for oviposition sites, Genesee Mtn., Jefferson Co. Colo., Aug. 1, 1984. 3 egg clusters of 5, 4, and 1 eggs per cluster (each cluster cemented in crevice with clear copious glue) found in healed crevices on twigs of C. montanus, Genesee Mtn., Jefferson Co. Colo., Aug. 8, 1984. Adults associated with Purshia tridentata; SSW Hot Sulfur Springs, Grand Co. Colo., July 4, 1990. Female crawled on and probed P. tridentata branches 12:57-13:32, outer branches first, and finally ended up near base of bush and laid 6 eggs 13:33 (oviposition took 80 sec.) on branch under strip of loose bark 7 mm wide beneath 9-mm-wide horizontal branch ~7 cm above ground, covering eggs was a transparent curtain of glue secreted by female; 5 eggshells found on bark of ~6-mm-wide branch of P. tridentata halfway from tip of branch to base; 3 preovipositions 10:30-11:15 crawling down P. tridentata branches and probing; SSW Hot Sulfur Springs, Grand Co. Colo., July 11, 1990. Evidently somewhat polyphagous on a variety of shrubs and small trees. Females (oddly) glue eggs in clusters (averaging 3.7 eggs) with a very copious clear glue, such that some eggs appear completely immersed in the glue, but the glue actually forms a thin film covering them, a "glue window". The film evidently provides protection against ants and desiccation. Obviously phylogenetically close to S. acadica, because of similarity of egg sculpturing, placement of eggs in holes, glue window, late-afternoon-early-evening mating time, and presence of orange cap on bluish unhatched spot. Eggs hibernate. Egg whitish-green, becoming slightly-grayish white, with numerous small hills each forming the hub of a spokelike set of 5-6 ridges, the hills narrower than those of S. acadica, micropylar crater very shallow.

Satyrium acadica (Edw.). Oviposition Salix exigua twig, Canon City, Fremont Co. Colo., July 10, 1970. 4 ovipositions by one female watched from 12:05 to ~13:03: she crawled down stems of S. exigua saplings, then landed on sapling 2.5 m tall, crawled 1 m down and at 12:17 laid 3 eggs into hole 1.7 mm wide (the scar where a twig broke off) on 11-mm-wide trunk and applied a glue window in hole covering eggs flush with top of outer egg; she then landed on S. exigua leaf and crawled 1 m down trunk and crawled onto a touching Salix lucida lasiandra branch of tree and probed abdomen 10 min. but was then scared away by ants, she crawled down a 1-m-high S. exigua sapling to its base in the grass, where she crawled around the 1-cm-wide trunk probing abdomen, then crawled up a little & basked; she flew to another 2.5-m-tall S. exigua, crawled down it ~1 m and laid 3 eggs at 12:45 (plus a narrow glue window around upper egg) into a hole 0.7 mm wide on 6-mm-wide trunk (the hole an exit hole made by some stem-boring bug) 4 mm below old twig base scar; she crawled 5 cm farther down trunk and laid one egg at 12:46 into hole 0.6 mm wide (exit hole of wood-boring bug) on 7-mm-wide trunk (a very narrow glue window was around one side of egg); she flew, then crawled down two 1.5-m-tall S. exigua saplings to ground and crawled around base of trunks in grass, crawled up and flew; at 13:00 she crawled down 2-m-tall sapling to 70 cm below tip and laid 6 eggs into a hole-crack 1.1 X 0.9 mm wide (in middle portion of crack ~4 mm long) on a 6-mm-wide branch (she made a glue window covering about half of the area of the first several eggs that were visible from outside the twig) (the crack led into an internal chamber made by a twig boring bug, which was filled with frass at one end and had a dead aphid at other end), she probed abdomen at a spot 4 cm farther down trunk, then flew up to 4-m-tall S. exigua and disappeared; Wheatridge, Jefferson Co. Colo., July 24, 1990. The female covers much of her eggs with a glue window as does Satyrium californica. Three of the egg holes were formed by some unknown tiny stem-boring insect and all three were packed with frass in the lower part of the internal chamber. Females display amazing physical dexterity during oviposition: they can place eggs that are 0.6 mm in diameter into holes only 0.6 mm in diameter, obviously by compressing the egg during its exit from the abdomen, and it takes the female only ~45 sec. to lay 3 eggs; the last oviposition also involved placing 4 of 6 eggs in the cavity ABOVE the level of the exit hole, proving that the extended ovipositor can be curved while the eggs are compressed and laid. Lab females lay eggs into holes in twigs. Associated with S. exigua in the rest of Colo. (Yuma, Jefferson Cos.) also, so evidently monophagous. Eggs hibernate. Egg purplish-brown when laid, the areas exposed to air (not covered by glue) becoming tan within 8 hours, whole egg becoming tan-white, covered with numerous small hills each forming the hub of a set of 5-6 ridges, micropylar crater fairly shallow with rim (rim red-brown when young).

Satyrium sylvinus sylvinus (Bdv.). Oviposition on twig of Salix exigua, Mirage, Saguache Co. Colo., Aug. 9, 1970. 2 eggs found on fork of a 7-mm-wide S. exigua stem beside (just above) a 10-cm-long branch of 15 leaves, eggs 60-cm

from tip of near-vertical branch; Castle Rock, Douglas Co. Colo., July 23, 1990. Preoviposition 12:40 S. exiqua, she probed abdomen at leaf bud 10 cm below twig end, and at twig fork nearby; N Greenwood, Douglas Co. Colo., July 23, 1990. Adults associated with S. exiqua, at N Greenland, Douglas Co. Colo. (July 19, 1990), at South Lake Gulch Road, Douglas Co. Colo. (July 19, 1990), and N Larkspur, Douglas Co. Colo. (July 23, 1990). Adults also associated with S. exiqua throughout Pueblo, Fremont, Custer, Saguache, Conejos, and Gunnison Co. Colo., Uintah and Kane Cos. Utah, and in northern New Mexico, so evidently monophagous. Eggs hibernate. Egg greenish-tan, after some days becoming pale tan-yellow, covered with numerous rounded-end tall pillars (these spines more pointed than S. acadica/californica), the spokelike ridges between hills much less apparent than on Satyrium acadica & californica, pits roughly hexagonal, micropylar crater deep but broad (0.2 mm wide) with tapered sides; no glue window (egg not in crevice), but glue was on main plant stem, some glue was between the two eggs, and glue was under each egg.

Satyrium liparops liparops (LeC.). One egg (compared with eggs dissected from female) found on Prunus (Padus) virginiana melanocarpa twig, preoviposition on P. v. melanocarpa twigs (note: Acer negundo, a hostplant I reported in J. Lepid. Soc. 22:159 and 1966 Lepidopterists' News #3 at this site, is erroneous); Lakewood, Jefferson Co. Colo., July 9, 1977. Female crawled down Prunus americana twigs 9:50-10:06, then crawled on a leaf some then crawled 4-5 cm toward base of horizontal stem and oviposited 10:13 on underside of 2-mm-wide P. americana red-brown twig just distal to a 4-leaf twiglet with 1-mm-wide stem, 14 cm from end of last leaf of branch, ~40 cm above ground; the same female flew 5 m W to a P. v. melanocarpa bush, landed on leaf and crawled ~30 cm down twig probing the twig with ovipositor, laid egg 10:45 into a 2-mm-deep crevice made by bark splitting away from a side twig, on vertical gray trunk 12 mm wide, 60 cm above ground and 10 cm basal to leaves; the same female landed on P. v. melanocarpa leaves and crawled down twig probing abdomen mostly at joints of twigs, and laid egg 10:49 on 3-mm-wide reddish-brown vertical twig just above and in a joint with a side twig 1.5 mm wide (2 cm below an inflorescence peduncle, 60 cm above ground, 20 cm from branch tip); a second female landed on leaf of a 50-cm-tall P. americana plant and crawled down twig probing often until she got just 2 cm above ground plants 15 cm above ground and laid egg 11:58 in crevice 1 mm deep consisting of peeled bark that stuck out 1 mm from side of gray trunk 8 mm wide, 2 mm below a gray 3-mm-wide side branch; preovip. 10:22 P. americana; all eggs laid in full or partial shade; Falcon County Park, Jefferson Co. Colo., July 10, 1990. Eggshell found in crotch of 4-mm- and 3-mm-wide stems ~30 cm into canopy of Crataegus succulenta (macracantha) var. occidentalis tree 2.7 m tall (egg sculpturing identical to known liparops); Falcon County Park, Jefferson Co. Colo., July 30, 1990. Eggs hibernate. Egg dull dark-brownish-red with numerous long sharp spines from entire surface, micropyle pit surrounded by ~15 wide villi-shaped projections that extend farther than the spines.

Satyrium calanus falacer (God.). Adults associated with Quercus gambelii in Jefferson, El Paso, Fremont, Custer, Saguache, Routt, Delta, and Garfield Cos. Colo., and Colfax Co. New Mex. However, two adults were found not near Q. gambelii: an adult in Lakewood, Jefferson Co. Colo., and several adults in Golden Gate Can., Jefferson Co. Colo., where perhaps Prunus (Padus) virginiana melanocarpa was eaten, or immigration occurred.

Satyrium calanus albidus Scott. Adults associated with Quercus gambelii in Routt, Delta, and Garfield Cos. Colo.

Satyrium auretorum (Bdv.). Oviposition Quercus sp. (live oak, leaves similar to those of Q. chrysolepis and others), Cascade Fall, Yosemite, Calif., July 8, 1964.

Satyrium saepium (Bdv.). Oviposition 11:23 on twig of Ceanothus fendleri, Lookout Mtn., Jefferson Co. Colo., July 11, 1977. Adults assoc. with C. fendleri, Russel Ridge, Douglas Co. Colo. Ovipositions 11:03 and 11:10 on side of 2 mm thick green stems of C. fendleri, Apex County Park, Jefferson Co. Colo., July 29, 1984. Oviposition 9:21 on underside of 3 mm wide C. fendleri stem, Mt. Zion, Jefferson Co. Colo., July 6, 1988. Egg in diapause found on C. fendleri stem, Indian Peak, Jefferson Co. Colo., April 21, 1989. Assoc. with C. fendleri in Colo., evidently the only host there. Adults assoc. with Ceanothus cuneatus (determined by park ranger), Valley of the Rogue Roadside Picnic Area, Josephine Co. Ore., July 15, 1964. Eggs are laid singly on smooth sides of thin stems, in contrast to S. californica. Eggs hibernate.

Satyrium behrii crossi (Field). Oviposition 9:10 on twig of Cercocarpus montanus, N fork Clear Creek, Gilpin Co. Colo., July 7, 1977. Egg found on stem of C. montanus and compared to dissected eggs, Lookout Mtn., Jefferson Co. Colo., July 8, 1977. Adults assoc. with C. montanus throughout Jefferson,

Custer, Fremont, and Saguache Cos. Colo., where it must be the only host. Eggs laid singly. Eggs hibernate.

Satyrium fuliginosum (Edw.). Oviposition on lower stems of Lupinus andersonii (Ha), females walk down the host stem and lay on stems or trash near the base, Sonora Pass, Mono Co. Calif., July 13, 1974. Oviposition near base of Lupinus meionanthus (Ha), Carson Pass, Alpine Co. Calif., July 20, 1974. Oviposition 10:15, she landed on Artemisia and fluttered short distances of 1/4 m from plant to plant, then landed on Lupinus prunophilus (formerly a ssp. of L. ammophilus) and crawled ~20 cm down stem and laid 2 eggs, one on top of the other, on side of a 3-mm-wide stem 2-3 cm above ground, then she fluttered from plant to plant again and at 10:20 landed on another L. prunophilus and crawled down stem and crawled on litter under plant for ~2-3 cm and bent abdomen straight down into a hole in litter ~4 mm (the abdomen remained still for several seconds so I think an egg was laid, but I searched through the litter and could not find the egg; however from past experience, eggs laid into litter by Plebejus melissa and Speyeria etc., or dropped into litter by Cercyonis, are very difficult to find), SSW Hot Sulfur Springs, Grand Co. Colo., June 30, 1989. Adults associated with L. prunophilus (a few Lupinus caudatus also present), SSW Hot Sulfur Springs, Grand Co. Colo., June 24, 28, 1989. Oviposition 13:40-13:58 L. prunophilus, I scared her up from one L. prunophilus plant and she fluttered weakly to another and crawled down it but was in sun so fluttered to a third plant, crawled down one leaf and got stuck on a cuplike 2nd leaf but after much turning crawled over it and down stem to litter below SSE base of plant, probed abdomen straight down for ~2 minutes, moved 3 cm to SE and probed litter ~1 min., then crawled 1 cm N and probed litter ~1-2 min; 4 eggs were later found in the litter (other eggs could have been missed in the tedious search), in 2 clusters of 2 eggs each, eggs were just laid into holes in litter and not attached to twigs; larvae are probably associated with ants, because ~20 ant head capsules were found in litter searched for these eggs, and ~20 5-7-mm-long vicious-biting red ants swarmed up out of the litter at the base of this plant when I collected the litter, and all the nearby plants also had ant nests (ants were common near 1989 eggs also); SSW Hot Sulfur Springs, Grand Co. Colo., July 4, 1990. Assoc. with L. caudatus (previously misidentified as L. argenteus), 1 mi. N Dillon, Summit Co. Colo., July 15, 1985. Adults associated with L. caudatus, NE Hayden, Routt Co. Colo., July 6, 1989. Eggs hibernate. EGG pale whitish-bluish-green with a tinge of tan, no micropylar crater, microscopically appearing like fresh-snow polygonal "mounds" ("mounds" actually the valleys between the ridges), each mound surrounded by a "slushy-ice" blue-green ring (the ridges and translucent knoblike narrow pillars occur on these darker rings, each pillar at the center of 5-6 radiating ridges). Other eggs tan, with each pillar forming the hub of 5-6 low ridges like spokes of a wheel; these eggs seem to owe their different appearance to the darker tan cuticle, which makes the pillars look wider, making the ridges slightly visible, and turns the "snow" valleys into tan flats. Blue-green may be the color of newly-laid eggs (persisting in the lab due to the death of the eggs?), tan the color of older eggs.

Callophrys eryphon eryphon (Bdv.). Adults assoc. with Pinus ponderosa var. scopulorum in most of Colorado, including Boulder, Jefferson, and Custer Cos., where it is undoubtedly the larval host, and some sites in Pueblo and Fremont Cos.; but in Fremont and Saguache Counties Pinus edulis Engelm. is the only conifer at many localities where it must be the host.

Callophrys polios Cook & Wats. (=obscurus F. & F.). Oviposition 13:35 on underside of leaf base next to Arctostaphylos uva-ursi adenotricha unexpanded flower buds, N Crawford Gulch, Jefferson Co. Colo., May 24, 1988. Oviposition 14:57 on lateral edge of leaf near end of branch (no new growth present), oviposition 15:24 on side of 8 mm long new leaf cluster (containing 7 new leaves) at end of branch, oviposition 15:06 on underside of leaf base next to 5 mm long leaf buds (~5 leaves rolled together) at end of branch, all on A. u. adenotricha, Stove Mtn., El Paso Co. Colo., May 28, 1988. Oviposition 13:51 and another egg found on A. u. adenotricha, both on leaf underside near edge of leaf 1 cm from young leaf buds, Tinytown, Jefferson Co. Colo., May 12, 1989.

Callophrys polios is strictly associated with A. u. adenotricha in Colo. C. polios and Callophrys augustinus have separate niches on this plant: polios usually lays eggs near young leaf buds (J. Cook, Can. Ent. 40:37, also states that females usually oviposit at base of elongate leaf buds, rarely on flower pedicels), augustinus at the base of flower pedicels, therefore polios larvae evidently prefer to eat young leaves, whereas augustinus larvae evidently prefer flowers and growing fruits. Eggs laid singly. EGG whitish-green, turning greenish-white. FIRST-STAGE LARVA light yellow, with a greenish internal tint after feeding, many long pale setae, T1 shield chitin-brown; head chitin-brown.

Callophrys augustinus augustinus (Westwood). Adults are ssp. augustinus in C

Colo., in adult appearance and hostplant. Oviposition 13:38 on base of corolla of Arctostaphylos uva-ursi adenotricha, preoviposition 13:34 on A. u. adenotricha, Russel Ridge, Douglas Co. Colo., May 11, 1988. Ovipositions 14:46, 14:52, 14:54, 15:19 and another egg found, all between scalelike stipule and base of flower pedicel except one egg on outside of stipule, of A. u. adenotricha, Tinytown, Jefferson Co. Colo., May 16, 1988. Oviposition 12:57 inside scalelike stipule at base of flower pedicel, oviposition 12:59 beside scalelike stipule at base of flower pedicel, both on A. u. adenotricha, Tinytown, Jefferson Co. Colo., May 17, 1988. Oviposition 14:11 inside bract at base of flower pedicel, another egg found on inside of bract at flower-pedicel base, both on A. u. adenotricha, Tinytown, Jefferson Co. Colo., May 5, 1989. Adults assoc. with A. u. adenotricha throughout the Colorado mountains east of the continental divide. In the lab, females from Indian Creek Cgd., Douglas Co. Colo., June 3-6, 1973 laid many eggs on A. u. adenotricha flowers near the pedicel (only one egg was laid on a leaf, next to a flower). C. augustinus larvae evidently eat flowers and growing fruits (J. Cook, Can. Ent. 38:214, also found that larvae first eat flowers, then feed on fruits, then mature larvae prefer leaves), whereas C. polios larvae evidently eat young leaves. Eggs laid singly. Egg light green.

Callophrys augustinus iroides (Bdv.). In SW Colo.-W N.M. adults are NOT associated with A. uva-ursi adenotricha. Adults common on Amelanchier sp. (though several were nectaring on its flowers thus it might not be a host), Gobernador Can., Rio Arriba Co. N. M., May 10, 1983. Adults associated with shrub Arctostaphylos, Creel, Chihuahua, Mex., March 30-31, 1969. SW Colo.-Mexico populations are possibly somewhat polyphagous as in Calif.

Callophrys mossii mossii (H. Edw.) (= schryveri Cross). Oviposition 9:50 one egg on underside of leaf base hidden between leaves near top of Sedum (Amerosedum) lanceolatum, Green Mtn., Jefferson Co. Colo., May 1, 1988.

Callophrys mossii doudoroffi dosP. (= windi Clench). Larvae raised on Sedum sp., South Yuba River NW Nevada City, Nevada Co. Calif., May 12, 1974. Larvae reared Dudleya cymosa (photo resembles cymosa), Loon Lake, El Dorado Co. Calif., June 9, 1974. Larvae reared Sedum sp., Lang Crossing, Nevada Co. Calif., June 15, 1974. Larvae raised Sedum spathulifolium, Lake Berryessa, Yolo Co. Calif., May 11, 1974. Adults are very local; a colony can occupy an area of only about 50 x 50 m. Pupae hibernate.

Callophrys gryneus nelsoni (Bdv.). The usual host is Calocedrus decurrens, so it is interesting that on top of the Sierra Nevada at Loon Lake, El Dorado Co. Calif., June 9, 1974, adults were common resting and flying about Juniperus occidentalis, the only species of Gymnosperm present and undoubtedly the hostplant. Adults of this population have the white unh median line usually weak, and thus are typical nelsoni; eastward below the Sierras in Calif.-Nev., Callophrys gryneus chalcosiva (Clench) has a strong white unh median line and also eats Juniperus.

Callophrys gryneus siva (Edw.). Adults associated with (resting on) Juniperus scopulorum, Red Rocks, Jefferson Co. Colo., May 25, 1988 and many other years, Lookout Mtn., Jefferson Co. Colo., May 30, 1988, Tinytown, Jefferson Co. Colo., June 2, 1988, Falcon County Park, Jefferson Co. Colo., June 6, 12, 1988. In Jefferson Co. Colo., J. scopulorum is the only juniper present at siva colonies so must be the hostplant.

Callophrys gryneus siva-gryneus. Adults associated with Juniperus, S Gothenburg, Dawson Co. Neb., June 7, 1990, June 15, 1991. Adults here are intergrades where the two ssp. meet and interbreed; many resemble siva, some resemble gryneus, and some lack the unh postbasal bar of gryneus but have the kinked postmedian line of gryneus; the postbasal bar is evidently inherited in a dominant/recessive fashion because it is either present or absent.

Callophrys affinis ("apama") homoperplexa B. & B. Oviposition on flower of Ceanothus fendleri, Chautauqua Mesa, Boulder Co. Colo., May 30, 1966. In Howe (1975) I assumed that this oviposition was a mistake by the female, but the following data prove it was not. Ovipositions 13:42 and 14:05 on base of terminal flower buds of C. fendleri and another egg found on bud, Tucker Gulch, Jefferson Co. Colo., June 5, 1980. Ovipositions 14:15-14:20 of 3 eggs between flower bud and sepal of C. fendleri, Apex County Park, Jeff. Co. Colo., June 6, 1980. Oviposition 14:42 on flower bud of C. fendleri, Apex County Park, June 11, 1980. Preoviposition 13:35 on C. fendleri flower buds, Apex County Park, June 13, 1980. Oviposition 11:20 C. fendleri flower bud, Apex County Park, June 24, 1980. Ovipositions 9:30 and 12:00 on C. fendleri flower buds, Ralston Butte, Jefferson Co. Colo., June 20, 1980.. Oviposition 14:35 C. fendleri flower bud, Tinytown, Jefferson Co. Colo., June 1, 1988. Ovipositions 11:25, 11:30, 11:35 C. fendleri young flower buds, same female tucked each egg out of sight between bract and flower bud, Tinytown, Jefferson Co. Colo., May 21, 1992.

position 10:54 between C. fendleri bract and inflorescence, Tinytown, Jefferson Co. Colo., June 11, 1992. Oviposition 11:25, 11:30, 11:35 and 1 egg found, all tucked inside red-edged bracts of young 5-mm-long C. fendleri inflorescences, Tinytown, Jefferson Co. Colo., May 21, 1992. Ovipositions 11:11, 11:57, 11:58, 12:00, and 1 other egg found, all eggs tucked out of sight between bract and flower bud of C. fendleri, eggshell found on flower bud near a first-stage larva whose head AND PROTHORAX were inserted into flower bud of Ceanothus herbaceus, Ralston Buttes, Jefferson Co. Colo., May 29, 1988. Oviposition 9:30 and preoviposition 9:32 on Eriogonum umbellatum var. umbellatum flower buds, Crawford Hill, Tucker Gulch, Jefferson Co. Colo., June 18, 1980. Preoviposition 12:00 on E. u. var. umbellatum flowers, Apex County Park, June 23, 1980. Oviposition 11:28 on flower bud of E. u. var. umbellatum (W), Chimney Gulch, Jefferson Co. Colo., June 28, 1978. Ovipositions 11:51, 11:52, 11:53, 11:56, tucked deep between unopened E. u. var. umbellatum flower buds, Van Bibber Creek, Jefferson Co. Colo., June 13, 1989. Female seen resting on Eriogonum jamesi var. flavescens flower buds, but no eggs found, Coal Creek, Jefferson Co. Colo., July 16, 1991. Lab larvae eat C. fendleri flower buds (but not the old hard fruits), eat E. u. var. umbellatum flower buds and occasionally leaves if buds are unavailable, and eat E. subalpinum (= umbellatum var. major) leaves when buds are unavailable. It is clear that both C. fendleri and E. u. var. umbellatum are hosts in nature (thus populations occur at some sites where C. fendleri is absent), even at the same site, and females seem to prefer to oviposit on whichever plant happens to be in the proper young flower bud stage. Many larvae were raised to pupae and adults in the lab. Pupae hibernate. Early stages (Tucker Gulch): EGG light bluish-green. FIRST-STAGE LARVA greenish-cream, prothorax cream; head orange-brown. MATURE LARVAE vary from green to red, but all have conspicuous subdorsal ridges edged medially by dark ground color, a lateral pale band edged above by dark ground color. These larval variants were found: 1) mature larva green, subdorsal ridges pink (cream edged by reddish), lateral ridge pinkish-cream, a light-green oblique subdorsal dash; 2) mature larva green, middorsal band reddish-tan, subdorsal ridges red, lateral ridge red, an oblique dark-red subdorsal dash; 3) mature larva red, the subdorsal ridges edged medially by dark-red, an oblique pink dash extending ventroposterad of anterior end of each subdorsal ridge, area between subdorsal & lateral ridges reddish-green on A3-6, a dark-red line just above red lateral ridge; 4) mature larva red, a cream lateral line, a cream subdorsal oblique dash. PUPAE also vary (pupa #1 came from larval type #1 I think, and the other color phases may also correspond to larval phases somewhat): 1) pupa pinkish-cream, head & thorax with a green tint, wings green, the posterior edge of T1-3-A1-6 and edge of wing all red (including 2 short red oblique subdorsal offshoots of red edge behind segments A1-6), a middorsal slightly darker band; 2) pupa ochre-red, thorax & wings yellow-brown, with a few blackish spots on dorsal part of wing case, small black subdorsal & middorsal abdomen spots; 3) pupa dark-red, wings dark-red-brown, with black spots on dorsal part of wing case, some black middorsal & subdorsal abdomen spots; 4) pupa red-brown, thorax & wings dark-red-brown, with black spots on dorsal part of wing case, some black middorsal & subdorsal abdomen spots.

Callophrys sheridanii sheridanii (Carp.). Oviposition 9:35 on top of tiny young 4 mm leaf in center of Eriogonum umbellatum var. umbellatum, Mt. Zion, Jefferson Co. Colo., April 30, 1988. Oviposition 10:50 on top of leaf blade next to new growth, oviposition 10:59 on side of petiole of young newly-grown leaf, oviposition 11:02 on top of petiole of young leaf next to new growth (all three ovips. by one female); oviposition 11:19 on top of new leaf blade next to new growth, oviposition 11:20 on tiny new leaf buds (both ovips. by one female); all in center of E. u. var. umbellatum plants; ovipositing females flutter slowly and land on plants resembling E. u. var. umbellatum, often on Heterotheca villosa; Indian Peak, Jefferson Co. Colo., April 21, 1989. Oviposition 13:10 underside of young leaf blade next to very young partly-expanded E. u. var. umbellatum leaves, she then landed on ~4 E. u. var. umbellatum plants, then flew over 3 Eriogonum jamesi var. flavescens plants without landing on them, Green Mtn., Jefferson Co. Colo., April 24, 1989. Adults (large variety) assoc. with Eriogonum jamesii var. wootenii (W), Cloudcroft, Otero Co. New Mex., April 21, 1972. EGG light green. FIRST-STAGE LARVA light yellow, prothorax grayish-yellow; head chitin-brown.

Callophrys sheridanii lemberti Tilden. Oviposition Eriogonum incanum (R), W Glen Alpine Falls, El Dorado Co. Calif., June 6, 1970.

Atlides halesus (Cram.) (= estesii Clench). Hibernating pupae found under bark on trunks of Juglans hindsii and Populus trichocarpa trees with Phoradendron sp., Sacramento River N of Clarksburg, Yolo Co. Calif., Feb. 23, 1974. Pupae found under bark of J. hindsii and Quercus sp. trees, W of Davis, Yolo Co.

82 Calif., March 1970. Strymon melinus Hubn. Larva raised from flowers of Astragalus bisulcatus, Central Plains Experimental Range, Weld Co. Colo., June 1976. Oviposition 10:33 on hairy side of Astragalus parryi flower bud, Tinytown, Jefferson Co. Colo., May 17, 1988. Ovipositions 9:05, 9:06 on stem of Astragalus adsurgens var. robustior inflorescence among flower buds, she did not land on A. agrestis (= dasyglottis) and fed on Astragalus flexuosus flowers but did not oviposit, Guy Hill, Jefferson Co. Colo., June 20, 1988. Oviposition 13:21 on young spiny fruit of Glycyrrhiza lepidota, Green Mtn., Jefferson Co. Colo., Aug. 4, 1978. Preoviposition G. lepidota flower buds, 2 eggs found inside bracts beneath G. lepidota flower buds, Wheatridge, Jefferson Co. Colo., July 13, 1988. Oviposition 10:55 G. lepidota flower buds, Marshall, Boulder Co. Colo., July 8, 1980. Oviposition 11:21 on young Lupinus argenteus flower bud, Shingle Creek, Jefferson Co. Colo., July 23, 1984. Oviposition 9:28 on L. argenteus flower bud, Golden Gate Can., Jefferson Co. Colo., July 6, 1980. Oviposition 9:16 base of calyx of unopened Psoralea (Psoralidium) tenuiflora flower, Red Rocks, Jefferson Co. Colo., July 4, 1988. A female bent abdomen on P. tenuiflora at 1130 but did not lay an egg (a common plant, but most butterflies shun it although Plebejus melissa adults feed on the flowers), Cherry Gulch, Jefferson Co. Colo., Aug. 17, 1987. Oviposition 9:12 on tiny leaf near flower of Malva neglecta, Red Rocks, Jefferson Co. Colo., Aug. 12, 1977. Oviposition 11:16 on top of 5 mm wide folded young leaf, another egg found also tucked into folds on leaf top, both next to M. neglecta flower bud, Cherry Creek Reservoir, Arapahoe Co. Colo., Sept. 21, 1988. Oviposition 10:30 on flower pedicel of Eriogonum effusum, Green Mtn., Jefferson Co. Colo., Aug. 12, 1977. Oviposition 12:35 on E. effusum pedicel, Green Mtn. Aug. 18, 1977. Oviposition 12:12 E. effusum flower, Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 9, 1987. Oviposition 12:43 between Eriogonum lonchophyllum flower buds, Bandimere Speedway, Jefferson Co. Colo., Aug. 10, 1984. 1 larva found (15 mm long, cream with reddish hairs and marks) on E. lonchophyllum flowers, Bandimere Speedway NE Morrison, Jefferson Co. Colo., Oct. 8, 1987. Oviposition 7 eggs 9:24-9:35 on flowers of Eriogonum (Pterogonum) alatum, Chimney Gulch, Jefferson Co. Colo., July 24, 1978. Ovipositions 12:36, 12:41 on bracts of E. alatum, and 12 eggs found on E. alatum (8 on old peduncles of flowers [seeds drop off leaving the peduncles near new flowers], 2 on side of flower, 1 on base of seed, 1 on calyx of seed), eggs are usually placed near new flowers in center of inflorescence, Red Rocks, Jefferson Co. Colo., Sept. 12, 1987. 22 eggs on peduncles, 1 egg on side of seed, 2 larvae on seeds (they burrow into seeds), all on E. alatum, Red Rocks, Jefferson Co. Colo., Sept. 21, 1987. 42 3rd- and 4th-stage larvae (nearly all parasitized by wasps) found on fruits (green seeds) of E. alatum, 3-mm-long black ants tend the larvae, Red Rocks, Jefferson Co. Colo., Sept. 22, 1987. Oviposition 10:27 on immature fruit of Rumex triangulivalvis, Green Mtn., Jefferson Co. Colo., Aug. 18, 1977. Oviposition 11:09 between flower buds of Verbascum thapsus, Lone Rock Cgd., Jefferson Co. Colo., Sept. 2, 1979. Ovipositions 10:04, 10:10 on top and side of bracts of flower buds of Mentzelia (Nuttallia) multiflora, Green Mtn., Jefferson Co. Colo., Aug. 10, 1984. Oviposition three eggs 13:15-13:20 (1 laid inside bract beside calyx tube, 1 laid on bract, 1 laid on side of calyx tube next to bract), ~8 eggshells found inside bract tips, 1 egg found on calyx tube near bract tip, 5 1st-2nd-stage larvae found boring into the calyx tubes (each calyx tube encloses unexpanded sepals, petals, & stamens at the end of an inferior ovary) (first they bore into side of calyx tube, then they bore in deeper, then they go completely inside calyx tube and feed on stamen tips and anthers), all on Mentzelia (Nuttallia) nuda; this female landed on Psoralea tenuiflora flowers twice but did not oviposit; N Golden, Jefferson Co. Colo., Aug. 8, 1989. Oviposition 10:40 on top of dentate M. nuda bract pressed against ovary; Barr Lake, Adams Co. Colo., Sept. 8, 1990. Oviposition 12:00 among unopened flower buds of Croton texensis, Barr Lake, Adams Co. Colo., Aug. 17, 1985. Larva 15 mm long found eating C. texensis flowers, Barr Lake, Adams Co. Colo., Sept. 28, 1987. Oviposition 10:06 in crack of branch tip where 4 petioles join, on Physalis virginiana var. longifolia (W) (one of the fruits had been eaten, possibly by S. melinus), Green Mtn., Sept. 7, 1985. 1 egg or small larva found on picked Jamesia americana flower buds, reared to pupa, Ralston Buttes, Jefferson Co. Colo., May 29, 1988. Oviposition 12:28 on young flower bud of Verbesina (Ximenesia) encelioides between outer row of disk flowers and next row inward, Barr Lake, Adams Co. Colo., Sept. 5, 1989. Preoviposition 11:30 crawling over Oxytropis lamberti flowers, S Midway, Pueblo Co. Colo., May 6, 1992. The most polyphagous North American butterfly, but nearly always chooses flower buds-flowers-fruits. Description of early stages (mature larvae & pupae mostly from Red Rocks on E. alatum, 1 each from Barr Lake, Ralston Butte, Bandimere Speedway): Egg light

grass-green when laid. FIRST-STAGE LARVA light orangish-yellow; head chitin-brown. MATURE LARVAE are incredibly variable in color (Table 3), but all have a narrow middorsal line edged by darker dashes, two oblique paler subdorsal dashes (the upper shorter) aimed posterolaterally (between these two obliques is the lower part of a paler check mark; the shorter upper part of the check is horizontal), and a row of lateral dashes edged by darker color.

Table 3. Mature larvae of Colo. Strymon melinus.

Overall Color	Ground Color	Mid-dorsal Line	Edge of Mid-dorsal	Obliques	Lateral Dashes	Edge of Laterals
pale-yellow with green marks	pale-yellow	pale-yellow	tan	green	cream	slightly green
ochre-yellow	yellow	yellow	tan (faint red)	tan (faint red)	yellow	tan (faint red)
cream with reddish marks (T1-2 reddish-cream)	cream	cream	red	red	cream	red
green with yellow marks	green	green	dark-green	dark-green below yellow check-mark	yellow	dark-green
green with yellow-green marks	green	green	dark-green	green edging lower arm of yellow-green check-mark	yellow-green	green
maroon with white marks	maroon	tan	maroon	white patch with pink center	white patches	maroon
tan with reddish marks	tan	greenish-tan	reddish-brown	red-brown	pink	red-brown
pink with white and red marks	pink	whitish-pink	red	red edges lower arm of pinkish white check-mark	whitish-pink	red
crimson	crimson	pink	crimson	red edges lower arm of pink check-mark	pink	red
crimson with pinkish-white marks	crimson	pink	crimson	same	pink	crimson

Polyommataini

Leptotes marina (Reak.). Oviposition 10:58 between unopened flower buds of Medicago sativa, 14 mi. N Camp Cottonwood, Montezuma Can., San Juan Co. Utah, Aug. 25, 1977. Oviposition 15:07 between M. sativa flower buds, Barr Lake, Adams Co. Colo., Sept. 5, 1989. Oviposition 13:00 on inflorescence of Dalea purpurea, Chimney Gulch, Jefferson Co. Colo., July 10, 1978. EGG greenish-

white.
Brephidium exilis exilis (Bdv.). Adults closely associated with Halogeton glomeratus (det. Hansford Shacklette), Warm Springs, Nye Co. Nevada, Sept. 20, 1973. Adults assoc. with Salsola australis (= iberica = "kali"), 4 mi. S Crowley, Crowley Co. Colo., Oct. 9, 1983. Adults associated with S. australis, 4 mi. S. Hopeton, Woods Co. Okla., Sept. 3, 1986.

Everes comyntas (God.). Ovipositions 14:00, 14:09, 14:11 Trifolium repens flowers, 10 mi. E of Colorado Springs, El Paso Co. Colo., Sept. 9, 1971. Ovipositions 11:30, 12:09 T. repens calyx, N Idledale, Jefferson Co. Colo., Aug. 21, 1977. Oviposition 13:38 T. repens leaf, Comanche Creek E of Kiowa, Elbert Co. Colo., Aug. 11, 1978. Adults associated with T. repens, NE Conger, Freeborn Co., Minn. June 16-18, 1986, June 19, 1987. 1 larva (much different from H. isola in appearance) found in papery Trifolium fragiferum seed heads picked and placed into boxes, ate flowers/fruits and bored into green seeds inside the brown papery calyx, reared to adult, Barr Lake, Adams Co. Colo., Sept. 28, 1987. Oviposition 14:58 on brown petal on underside of ball head, female bent abdomen in flowers 14:50, 14:55, all on Trifolium hybridum, NE Alden, Freeborn Co., Minn., June 23, 1991. Oviposition 12:04 on side of stem 1 cm from branch tip, oviposition 12:05 on outside base of 2 mm long bract at base of immature inflorescence, both on Lotus corniculatus, rest stop 1 mi NE Underwood, Pottawattamie Co. Iowa, May 30, 1989. T. repens is probably the main Colo. host based on its abundance and the fact that adults occur only along creeks or wet swales on the plains and lower foothills in Colo. (E. comyntas is sympatric with E. amyntula at Hardscrabble Can. in Custer Co., and Tucker Gulch, gulch N Idledale, and gulch NE end Green Mtn., all in Jefferson Co., whereas amyntula occurs on drier slopes gulches etc. in the mountains.) Eggs are laid on flowers, so larvae probably usually eat flowers/fruits, less often leaves. EGG (Colo. & Iowa) whitish-green. 1ST-STAGE LARVA yellow-cream; head black. Mature larva/pupa (Barr Lake): MATURE LARVA maroon with lighter bands and a slight frosting of pale points, a middorsal dark-brown band (formed of minute black points), two gray slightly-oblique (sloping rearward on each segment) subdorsal bands (the upper wider) with a diffuse gray anterior spot below the lower oblique band, a paler (gray) lateral band; prepupa turning green with reddish-brown top with markings). PUPA wings translucent-light-olive-green, abdomen tan, top of thorax greenish-brown, a brown middorsal band (narrow on thorax, on abdomen interrupted between segments), a weak diffuse brown subdorsal patch on T2 and T3, a black subdorsal dash on A1 and A2, a brown subdorsal spot on A3-7, pupa covered except on wings with 1-mm white hair.

Everes amyntula (Bdv.). Oviposition Astragalus flexuosus (W), Chautauqua Mesa, Boulder Co. Colo., May 1965 (reported wrongly as E. comyntas valeriae Clench by me in J. Lepid. Soc. 22:165). Oviposition 10:37 on fork of stem of A. flexuosus (W), Tinytown, Jefferson Co. Colo., July 26, 1978. Oviposition 9:09 on junction of stems 5 cm below flowers of A. flexuosus, Green Mtn., Jefferson Co. Colo., May 12, 1980. Oviposition 9:24 in crack of stem just above a leaf, on A. flexuosus, Green Mtn., Jefferson Co. Colo., June 15, 1985. 2 eggs found (1 on leaf rachis at base of lowest leaflet, 1 on stem 1.5 cm below leaf and 5 cm below base of flower buds) of A. flexuosus; Tinytown, Jefferson Co. Colo., June 21, 1990. Adults associated with Astragalus miser var. oblongifolius (G), Lake Creek Cgd., Custer Co. Colo., July 13, 1971. Adults associated with Lathyrus polyphyllus (C), SE Copper, Siskiyou Co. Calif., May 19, 1974. Oviposition 9:01 on leaf near flower of Lathyrus leucanthus (W), Jarre Can., Douglas Co. Colo., May 26, 1978. Oviposition 11:38 in crook of stem 6 cm below branch tip L. leucanthus, Lookout Mtn., Jefferson Co. Colo., May 30, 1988. Oviposition 11:35, she fed on flowers then probed abdomen into base of flower then walked down stem to lay on top of L. leucanthus stem at base of leaf 7 mm above junction of flower cluster; Apex Gulch, Jefferson Co. Colo., June 5, 1990. 9 eggs found on pedicels (mostly at junctions), 1 egg on petal beside sepal, of L. leucanthus; Apex County Park, Jefferson Co. Colo., May 29, 1991. 9 eggs (6 on junction of pedicels below flower, 3 on sepals) found on Lathyrus polymorphus incanus, S. Table Mtn., Jefferson Co. Colo., May 30, 1991. 2 eggs found in crotch of pedicels below Lathyrus eucosmus flowers, 4 eggs (3 sepals, 1 on grass stem of Bromus tectorum next to flower) found on (1 beside) Vicia americana flowers, Green Mtn., Jefferson Co. Colo., June 3, 1991. Oviposition 13:00 on flower pedicel, and several other eggs found on calyx, of V. americana, North Table Mtn., Jefferson Co. Colo., May 23, 1980. 1 egg found in second crotch below V. americana flower, 1 egg found on 2nd joint below white Lathyrus leucanthus flower, Mt. Vernon Historic Site, Jefferson Co. Colo., June 4, 1991. Adults associated with V. americana, Green Mtn., Jefferson Co. Colo., May 2, 1989. HOSTPLANTS: Astragalus flexuosus, Lathyrus leucanthus, L. polymorphus incanus, L. eucosmus, Vicia americana. Lathyrus and Vicia have tendrils, and

based on other published records, E. amyntula prefers these tendril-plants; however A. flexuosus is also a popular host (and it is the most popular legume hostplant for Colorado butterflies that eat legumes--it also has the smallest leaves of Colo. legumes, fitting a known trend that the plants least visible to herbivores tend to be the most edible). L. leucanthus (and probably the other Lathyrus and Vicia) dries up by Sept., so is eaten only by the first generation; Astragalus flexuosus is green for later generations. Eggs are usually laid in or near junctions (pedicel-stem, stem-petiole), so larvae probably eat leaves as often as, or more often than, flowers/fruits. Egg greenish-white with long white hair, the pillars a little closer together than E. comyntas, the ridges (but not pillars) larger than E. comyntas. 1ST-STAGE LARVA yellow-cream, suranal plate and pronotum with a slight tan tinge; head black.

Celastrina "lucia-type" form violacea (Edw.) (= sidara [Clench]). This taxon is called "lucia-type" because it is the single-generation spring ecotype which contains the form lucia; and electrophoresis study of adults (David M. Wright, pers. comm.) I sent from Red Rocks, Jefferson Co. Colo., proved that they are related to the boreal N. Amer. populations that also contain form lucia. Further studies by Wright may show what the species' name should be. 40 eggs (identical to eggs dissected from females) found on inflorescences of Jamesia americana, two eggs on Prunus (Padus) virginiana melanocarpa inflorescence, three eggs on Physocarpus monogynus inflorescence, one egg on Humulus lupulus americanus (= neomexicanus) inflorescence, while no eggs were found on inflorescences of Rubus (Oreobatus) deliciosus, Aquilegia sp., Crataegus sp., Acer glabrum, a white-flowered Apiaceae sp., and Smilacina racemosa var. amplexicaulis, all Red Rocks, Jefferson Co. Colo., May 22-23, 1977. Ovipositions 10:35, 10:36, 10:38 on flower buds of J. americana shrub partially leafing out, Mt. Zion, Jefferson Co. Colo., May 3, 1986. Ovipositions 12:28, 12:29, 6 eggs found, all on hairy side of J. americana flower buds, Tinytown, Jefferson Co. Colo., May 16, 1988. 8 eggs found on J. americana flower buds, no eggs found on Amelanchier alnifolia flower buds, no eggs found on Prunus virginiana melanocarpa flower buds, Crawford Gulch, Jefferson Co. Colo., May 24, 1988. Oviposition 11:54 and ~40 eggs found, all on J. americana flower buds (a form marginata also oviposited 11:29 on J. americana, see below), Red Rocks, Jefferson Co. Colo., May 25, 1988. 2 eggs & a 1st-stage larva found on J. americana flower buds, Van Bibber Creek, Jefferson Co. Colo., May 26, 1988. 2 eggshells found on J. americana flower buds, Falcon County Park, Jefferson Co. Colo., June 12, 1988. Oviposition 11:16 unopened Holodiscus dumosus flower buds; 1 egg found on J. americana flower buds; Mt. Zion, Jefferson Co. Colo., June 11, 1978. Oviposition 9:47 J. americana flower bud pedicel base; 6 eggs found on H. dumosus flower buds; Mt. Zion, Jefferson Co. Colo., May 25, 1988. 6 eggs found on J. americana flower buds, a few H. dumosus flower buds had no eggs, Stove Mtn., ~10,000 feet, El Paso Co. Colo., May 28, 1988. 1 egg found on H. dumosus flower bud, W Idledale, Jefferson Co. Colo., June 6, 1988. Preoviposition 10:30 on Humulus lupulus americanus for 10 minutes, Red Rocks, Jefferson Co. Colo., June 15, 1987. Oviposition 10:27 between Cornus (Swida) sericea (= stonolifera) flower buds, Russel Ridge, Douglas Co. Colo., May 27, 1988. 3 eggs found on C. sericea flower buds (on bud petiole, petiole-sepal, on sepal), no eggs found on Lonicera involucrata flower buds, Tinytown, Jefferson Co. Colo., June 1, 1988. Half-grown larva found on C. sericea growing fruits, Tinytown, Jefferson Co. Colo., July 4, 1991. Oviposition 12:15 on side of Ceanothus fendleri flower buds, two females repeatedly landed on C. fendleri flower buds whereas other females ignored this plant (indicating possible learning of hostplant), 37 eggs found on J. americana flower buds, Ralston Buttes, Jefferson Co. Colo., May 29, 1988. No eggs found on Amelanchier alnifolia flower buds, Tinytown, Jefferson Co. Colo., June 2, 1988. 2 eggs found on very immature J. americana flower buds (Prunus virginiana melanocarpa, P. americana, and Crataegus flowers were past peak bloom), Red Rocks, Jefferson Co. Colo., May 3, 1989. 2 eggs found on J. americana flower buds, Tinytown, Jefferson Co. Colo., May 18, 1989. 3 eggshells and 2 nearby 1st-stage larvae found on J. americana flower buds, N fork Clear Creek, Gilpin Co. Colo., June 14, 1989. One egg, ~20 eggshells, and 12 larvae 1.5-3 mm long found on J. americana flower buds, at 12:59 a preovipositing female landed on Achillea lanulosa and Physocarpus monogynus flowers but refused to oviposit, Phillipsburg, Jefferson Co. Colo., June 17, 1989. 2 eggshells found on J. americana flower buds, Tucker Hill, Jefferson Co. Colo., June 18, 1989. 1 egg found on Jamesia americana flower bud, W Deckers, Jefferson Co. Colo., June 10, 1991. ~40 larvae (half- to full-grown) found on J. americana flowers, most reared to pupae used for adult emergence test, 3 species of ants palpating larvae, Tinytown, Jefferson Co. Colo., July 1 & 2, 1991. Preoviposition 10:40 Prunus virginiana melanocarpa flower buds, ignored Amelanchier alnifolia flower

buds, Tintown, Jefferson Co. Colo., May 21, 1992. Ant workers were found on larvae on Jamesia at Tintown: Camponotus modoc, Formica podzolica, F. neorufibarbis, Tapinoma sessile (David M. Wright will report details). Larvae of at least some taxa of North American Celastrina eat many plant species of numerous families, and females oviposit only on plants in the proper flower bud stage, so the plants oviposited upon change during the season. But in Colorado Jamesia americana is by far the most common host for the lucia-type, which has adapted only to it (only one generation occurs in Colo. so there is no adaptation to later-blooming hosts); Holodiscus dumosus, Cornus sericea, Physocarpus monoquynus, Prunus virginiana melanocarpa, Ceanothus fendleri, and Humulus lupulus americanus are chosen only rarely. Cornus is a popular host in E U.S. and Calif. but the plant is rare in Colo. C. lucia-type forms (violacea, lucia, lucimargina, and marginata) occur all over wooded north-facing slopes, from gulch bottoms to ridgetops on the N-slopes, and the hostplant J. americana also occurs on N-facing slopes from just above the gulch to just below the ridgetop. J. americana is an ancient plant, fossilized in volcanic ash near Creede Colo. The forms of C. "lucia-type" are distributed in an interesting manner in Colo.-N.M.: form violacea is everywhere, but forms lucia, lucimargina Scott, and marginata occur only south to Jefferson Co. on the eastern slope of the continental divide (where they are uncommon; only a dozen or so lucia have been found in Jefferson Co.; in El Paso Co. the closest adults to lucia that I have found are 2 with slight enlargement of central dots on only one hindwing); in contrast, these three forms are common on the wetter western slope of the continental divide (common south to the San Juan Mts., and south to NW New Mex. near Dulce Lake, Rio Arriba Co.), where the black unh blotch of lucia is often extremely large (4.5 mm long, the largest I have seen anywhere in N. Amer.). Evidently the wetter conditions on the western slope cause this difference. C. "lucia-type" form neglecta (whitish adults of a second generation) is very rare in Colo. (1 female Little Fountain Creek, 7000', El Paso Colo. Aug. 9, 1971; 1 male 4 mi. S Beulah, Wet Mts., Pueblo Co. Colo. Aug. 4, 1962); I consider these to be C. lucia-type because C. neglecta is unknown there. One deformed male resembling form violacea was found Aug. 15, 1986, at O'Fallon Park, Jefferson Co., Colo. (only violacea occurs at this site); this late date could suggest that form violacea is genetic. Also, several reared 1988 pupae of violacea produced deformed adults in the lab in Aug. (most pupae diapause and do not hatch even in the lab) which also resembled violacea and not neglecta or C. neglecta hop-ecotype (in contrast, lab C. neglecta hop-ecotype produced whitish C. neglecta hop-ecotype adults), which also seems to indicate that violacea is genetic. It is tempting to claim that the wing pattern differences between the two are genetic because in my rearings violacea always produced violacea and C. neglecta hop-ecotype always produced C. neglecta hop-ecotype (and the lack of seasonal forms in Calif.-Ariz.-W Texas Celastrina seems to indicate that the absence of form violacea in those whitish populations is genetic); however, my lab rearings merely used the environment of my basement rather than carefully-controlled environmental chambers, and in E U.S. W. Edwards and C. Oliver have raised form neglecta from form violacea (but it is possible that only one or two E U.S. taxa have the capacity to produce environmental forms, whereas these forms are genetically fixed in the other taxa including the Colo. taxa; but this will have to be proven). Early stages (from Red Rocks, Mt. Zion, Tintown, Crawford Gulch, Ralston Butte): EGG pale bluish-green, becoming greenish-white. FIRST-STAGE LARVA yellow-cream (slightly yellower than C. neglecta hop-ecotype and C. neglecta lupine-ecotype), with a faint darker-yellow middorsal band, after feeding turning greenish inside, prothoracic shield yellow-cream, D2 very short or short (apparently averaging shorter than C. neglecta), L3 short (apparently averaging slightly shorter than C. neglecta); head black. MATURE LARVAE have a darker middorsal band and a darker oblique band on prothorax, a middorsal darker band (consisting of large square spots on T2-3-A1, anteriorly-directed smaller triangles on A2-6 [or rectangles on A2-3], a variably-shaped spot on A7, a band on A8-10), on each segment a paler dash beside the middorsal band, then a darker slightly oblique streak or dash (sometimes faint, in which case a large pale spot is formed of the adjacent pale dashes), then a strongly-oblique pale streak, below it a dark streak (varying to black in the darkest larvae), then a weak pale spot or short dash, a darker area, and a lateral pale band along the larva; head brown. But the overall larval color varies between larvae, from yellow-green (only 1 larva seen) to bluish-green (only 1 larva seen) to pale-green to green to green with tan middorsal band to green with maroon-and-white markings to brown with white markings (only 1 larva seen)(Table 4); the variation is continuous from the paler to browner larvae, and all the variants except the extremes are common. Greenish larvae are most common; the larvae are generally less yellow-green than C. neglecta hop-ecotype. PUPA

abdomen & wings ochre (paler than C. neglecta hop-ecotype), head and top of thorax mottled dark-brown (in C. neglecta hop-ecotype the head, thorax, and abdomen are all mottled slightly-reddish brown with the top of abdomen only slightly paler), a middorsal dark-brown band on thorax and abdomen, a black spot on shoulder of wing, a subdorsal black spot on T3 (small), A1 (big; these two spots are adjacent), A3 (tiny), A4 (small, twinned), A5 & A6 (twinned, large in some pupae, tiny in others); as emergence nears, the eyes and proboscis tip turn black before the rest of pupa. Pupae differ from C. neglecta hop-ecotype by having the abdomen (& usually the wings) usually paler (C. neglecta hop-ecotype have thorax more similar in color to abdomen & wings), thus the top of thorax appears darker, though the difference is not enough to identify all pupae. Pupae hibernate.

Table 4. Mature larvae of Colo. Celastrina "lucia-type" form violacea.

Overall Color	Ground Color	Mid-dorsal Band	Subdorsal & Obliques	Lateral Band	Edge of Laterals
red-purple	red-purple	dark red-purple	pink	pink	red-purple
red-purple with pink lines	red-purple	purple-red-	pale-pink	pale-pink	red-purple
brown & white	greenish-white	maroon-brown	white & - slightly maroon (black below)	tan-white (rear of each segment maroon)	pale-maroon-brown
green, maroon, white	dark-green	maroon	white & maroon	white (reddish on rear in 1 of 2 larvae)	pale-green
green with maroon & cream	green	maroon-brown	cream & green	cream	pale-maroon
light-green with maroon & cream	pale-olive-green	maroon	greenish-white & pale-olive-green	greenish-white	translucent-pale-maroon
brown, white, green	dark-green	brown	brownish-cream & tan (black below)	brownish-cream	tan
green with brown middorsal	green	brown	greenish-cream & green	greenish-cream	green
green with light-brown middorsal	green	light-brown	light-green & green	light-tan-green	green
mottled bluish-green	pale-blue-green	tan	pale-blue-green & blue-green	slightly-tan-blue-green	pale-blue-green
mottled-pale-green	whitish-green	tan	greenish-white & green	greenish-white	green
mottled-green	green	green	pale-green & green	yellow-green	green
green	green	dark-green	lighter-green	lighter-green	green

mottled- yellow- green	yellow- green	dark- green	yellow-green & dark-green	yellow-green	dark- green
mottled- greenish- gray (prepupa?)	green- ish- gray	gray	gray & creamy- gray	creamy-gray	gray

Celastrina "lucia-type" form marginata (Edw.). Oviposition 11:29 (the female tending toward form marginata) Jamesia americana flower buds (form violacea eggs also found here, see above), Red Rocks, Jefferson Co. Colo., May 25, 1988. Oviposition 11:46 by marginata female on Prunus (Padus) virginiana melanocarpa flower bud, ridgetop N Apex Gulch, Jefferson Co. Colo., May 8, 1989.

Celastrina "lucia-type" form lucia (Kirby). Oviposition 12:07 on side of Jamesia americana flower bud, Ralston Buttes, Jefferson Co. Colo., May 29, 1988. Forms marginata and lucia are obviously the same species as form violacea, as they fly together (forms violacea, marginata, lucimargina, and lucia fly at the same time and in the same habitats), have the same hostplant, and are connected to violacea (and to forms marginata and lucimargina) by numerous adults intermediate in wing pattern. A mature lucia larva from Lukinto Lake Ontario (Jim Troubridge coll.) is light green with slightly-paler-green markings, pronotum light brown; the pupa from there resembles Colo. violacea in its middorsal band and black spots and also has a paler (ochre) abdomen, though the head-thorax-wings are greenish-tan; so perhaps the paler (ochre) pupal abdomen is characteristic of C. "lucia-type".

Celastrina neglecta (Edw.) dogwood-ecotype. Presumably this taxon is C. neglecta, but I am uncertain. 12 eggs & 3 eggshells found on Cornus ("Swida") sericea (= stolonifera) flower buds (14 on green ovary, 1 on side of white unopened petal; about half the eggs on plants with red petioles, half with green petioles); Halls of Humes Lake, Freeborn Co., Minn., June 14-15, 1990. Eggshell found on C. sericea tiny fruit, Halls of Humes Lake, Freeborn Co., Minn., June 22, 1991. Adults associated with C. sericea flowers, Helmer Myre State Park, Freeborn Co., Minn., June 16, 1986. Adults associated with C. sericea flowers, Walnut Lake Wildlife area, Faribault Co. Minn., June 15, 1986. Adults associated with (flying about the canopy of) C. sericea flowers, 3 mi. S Elkhart exit (exit 96), Polk Co. Iowa, June 12, 1986. Egg pale-bluish-green; color & sculpturing like other Celastrina.

Celastrina neglecta hop-ecotype. Electrophoresis study of adults (David M. Wright, pers. comm.) I sent from Red Rocks, Jefferson Co. Colo., proved that this taxon is similar to (a few alleles differ) the common E U.S. taxon that Wright will call C. neglecta in his forthcoming work on evolution and ecology of N. Amer. Celastrina. Adults are all the summer form neglecta (unh white, males sometimes with a slight amount of whitish on uph, female ups usually mostly blue with some whitish but in some females the blue mostly replaced by white). Colorado C. neglecta hop-ecotype is limited to the lower-altitude northern Front Range: I found it in foothills in Jefferson Co. (from S of Wilds Peak N to Coal Creek Can.) and Boulder Co. (Gregory Can.), (Paul Opler has found it at two sites in the Larimer Co. foothills), farther into the mountains in Gilpin Co. (N Fork Clear Creek), and barely onto the plains along Clear Creek (at Wheatridge, Jefferson Co.). Many ovipositions and ~200 eggs and young larvae found on inflorescences (most on male but some on female inflorescences) of Humulus lupulus americanus (= neomexicanus), June 24, 1973, ovipositions 9:21 and 13:25 on H. l. americanus inflorescences, June 28, 1973, several eggs on H. l. americanus inflorescence, June 30, 1973, all Red Rocks, Jefferson Co. Colo.; many larvae, which eat mostly male flowers and flower buds, were raised to pupae, which all hibernated in the lab except for 4 which emerged in July as form neglecta. Oviposition 12:54 on male unopened flower buds of H. l. americanus, Chimney Gulch, Jefferson Co. Colo., July 1, 1978. Two eggs on side of inflorescence of H. l. americanus, Mother Cabrini Shrine, Jefferson Co. Colo., June 24, 1980. Ovipositions 9:20, 10:15, 10:25 on H. l. americanus male flower buds, Red Rocks, Jefferson Co. Colo., June 27, 1980. 1 male and a few H. l. americanus vines seen, N fork Clear Creek, Gilpin Co. Colo., July 1, 1981. Three eggs found on inflorescence bracts of H. l. americanus, Apex Gulch, Jefferson Co. Colo., July 3, 1984. Adults associated with H. l. americanus, W of Idledale, Jefferson Co. Colo., June 15-19, 1984. Adults associated with H. l. americanus, Cherry Gulch, Jefferson Co. Colo., July 7, 1984. Oviposition

10:30 on male flower bud of H. l. americanus, Red Rocks, Jefferson Co. Colo., June 15, 1987. 5 larvae found on H. l. americanus flowers, Red Rocks, Jefferson Co. Colo., July 20, 1987. ~20 eggs found on H. l. americanus male flower buds (even though female cones are more common than male flower buds), Red Rocks, Jefferson Co. Colo., July 4, 1988. Hatched egg found on H. l. americanus male inflorescence, Coal Creek Can., Jefferson Co. Colo., July 1, 1986. 8 larvae found on male flowers of H. l. americanus, W Idledale, Jefferson Co. Colo., July 24, 1987. 1 larva found on H. l. americanus flowers, Mother Cabrini Shrine, Jefferson Co. Colo., July 23, 1987. 7 eggs found on H. l. americanus male flower buds, Chimney Gulch, Jefferson Co. Colo., June 24, 1988. 5 eggs found on H. l. americanus male flower buds, Red Rocks, Jefferson Co. Colo., June 25, 1989. 6 eggs found on base of sepals of male flower buds of H. l. americanus, Mother Cabrini Shrine, Jefferson Co. Colo., June 26, 1989. Male flew out from H. l. americanus vine, Wheatridge, Jefferson Co. Colo., July 11, 1989. 7 larvae found on H. l. americanus flower buds (3 larvae half grown, 4 larvae three-fourths grown), Chimney Gulch, Jefferson Co. Colo., July 16, 1989. A 3/4-grown larva found on H. l. americanus male flower buds, Apex Gulch, Jefferson Co. Colo., July 17, 1989. 8 larvae found on H. l. americanus male flower buds (two 1/3-grown, two 3/4-grown, 4 half-grown), Apex Gulch, Jefferson Co. Colo., July 18, 1989. Oviposition 13:40, preovipositions 12:12 and 13:20, and 18 eggs (1 on side of stem near buds, 1 on side of bract below buds, 16 tucked in among buds) found, all on H. l. americanus flower buds; Red Rocks, Jefferson Co. Colo., June 18, 1990. Oviposition 12:07 and 1 egg found, on male H. l. americanus flower buds; Red Rocks, Jefferson Co. Colo., June 19, 1990. 5 larvae 6-10-mm long found on male H. l. americanus flowers, reared to 4 diapausing pupae; Wheatridge, Jefferson Co. Colo., July 7, 1990. 2 mature larvae found on male H. l. americanus flower buds; Wheatridge, Jefferson Co. Colo., July 14, 1990. 1 egg, 6 eggshells, and ~31 larvae found on male flower buds, 2 sp. of ants palpating larvae, most reared to pupae and some used for adult emergence test, 1 egg 1 eggshell found on female flower buds, all on H. l. americanus; Red Rocks, Jefferson Co. Colo., July 5, 1991. 2 eggshells 1 half-grown larva found on H. l. americanus male flower buds, Wheatridge, Jefferson Co. Colo., July 6, 1991. 22 larvae found on H. l. americanus male flower buds, most reared to pupae used for adult emergence test, 2 species of ants palpating larvae, Coal Creek, Jefferson Co. Colo., July 9, 1991. Ant workers were found on larvae on Humulus: Formica podzolica at Red Rocks, Tapinoma sessile at Red Rocks, Apex Gulch, Coal Creek. C. neglecta hop-ecotype is restricted to Humulus (hops), and only occurs where this plant grows, generally only in gulch bottoms. Humulus lupulus is evidently native to the Colo. mountains, because the leaves of the native H. l. americanus are more incised than those of the cultivated variety H. l. var. lupulus, although some hybridization may have occurred; the large Coors Brewery in Golden, Jefferson Co. Colo., was started in 1873, and the first Colo. brewery (Rocky Mountain Brewery, later Zang's Brewery) was started in Denver Nov. 1859, and these and other breweries could have planted cultivated hops to flavor their beer (the pinecone-like female "catkins" are used for beer), and C. neglecta may have discovered the abundant and non-harvested male inflorescences and founded a population on Humulus. But such plantings were few if they occurred at all, hops are not cultivated in the area now (beer hops are grown in Idaho etc.), and all the evidence indicates that H. l. americanus and C. neglecta hop-ecotype have been present in Colo. for thousands of years (H. l. americanus fossil leaves have even been found in Oligocene Florissant shale). The species status of C. neglecta hop-ecotype was previously considered dubious because all the wing pattern and hostplant differences between it and C. lucia-type form violacea could be environmental: C. neglecta hop-ecotype resembles the extremely rare summer C. lucia-type form neglecta, and several E. U.S. workers have reared neglecta from violacea. Also, mature-larval color pattern of lucia-type and C. neglecta hop-ecotype are very similar in Colo., and I am not certain that there is any difference (both vary the same way). I once thought that C. neglecta hop-ecotype develops from eggs laid by early-emerging C. lucia-type form violacea, with most of the pupae of both forms (except for the early violacea) hibernating. But in 1991 a late spring resulted in both flights overlapping much more than usual with only a week or two average difference, obviously a time too short for one to produce the other. In my opinion there is seldom enough time in nature for lucia-type larvae to grow on Jamesia americana flowers and pupate in time for the C. neglecta hop-ecotype flight; both have just one yearly generation (considerable time was spent at C. neglecta hop-ecotype sites without seeing any adults in May and L July to Sept.), except for the very few whitish adults found in Aug. at sites where C. lucia-type form violacea flies that I am calling C. lucia-type form neglecta. And I have now reared both C. neglecta hop-ecotype and C. lucia-type form violacea in Colo., and nearly all

the pupae of both forms hibernated at least in my lab conditions. Three lab rearings of C. neglecta hop-ecotype were done: 1973 pupae were not refrigerated and several adults with unh even whiter than normal emerged from pupae in early Aug. while most pupae stayed in diapause and never emerged; 1987 pupae diapaused and did not produce adults; 1989 pupae were refrigerated and about half produced adults of normal white appearance ~6 weeks after removing them from refrigeration in early Jan. and the remaining pupae did not produce adults. David Wright experimented on emergence of both species using pupae that I sent and he found that C. neglecta hop-ecotype pupae take longer to hatch after removal from refrigeration than C. lucia-type, which explains the difference in timing of their flight periods. And C. neglecta hop-ecotype seems to be a separate species from lucia-type for other reasons: the hostplants differ almost completely (C. neglecta hop-ecotype is completely restricted to Humulus whereas C. lucia-type eats Jamesia americana and rarely others); C. neglecta hop-ecotype is very local only in gulch bottoms near Humulus (mainly in sunny rocky or steep areas because the hostplant grows well on rockslides though some plants grow on other shrubs), whereas C. lucia-type occurs on wooded north-facing slopes (from the gulch bottom to the ridgetop); during every year the start of the C. neglecta hop-ecotype flight overlaps the end of the lucia-type flight (they fly together at EVERY C. neglecta hop-ecotype site except Mother Cabrini Shrine & Wheatridge) so that worn male C. lucia-type could mate with emerging female C. neglecta hop-ecotype (in Colo., C. lucia-type typically peaks in late May, C. neglecta hop-ecotype in mid June); in addition, the two differ in pupal color and slightly in first-stage larval morphology. It seems that Colo. C. neglecta hop-ecotype is a distinct biological species that rarely if ever mates with C. lucia-type, though it is possibly not totally reproductively isolated. C. neglecta hop-ecotype is analogous to C. neglectamajor Opler & Krizek of eastern U.S., because adults are white in both, and both fly several weeks after form violacea (William H. Edwards, 1868-1897 etc., used the name pseudargiolus for C. neglectamajor, which varies in size from large to the size of violacea); however, Colo. C. neglecta hop-ecotype is the same size almost as form C. lucia-type form violacea, whereas C. neglectamajor is often larger, and the hostplants differ between C. neglecta hop-ecotype and C. neglectamajor (usually Cimicifuga racemosa for neglectamajor). In E U.S. C. neglectamajor has often been considered a separate species. I sent 1st-stage larvae of both Colo. C. lucia-type form violacea and C. neglecta hop-ecotype to David M. Wright, who has been studying Celastrina in eastern U.S.; he compared them to eastern material and found that Colo. lucia-type and C. neglecta hop-ecotype are not related to C. neglectamajor (which has first-stage larvae somewhat different from those of other eastern Celastrina); he found that first-stage larvae of Colo. C. lucia-type form violacea and C. neglecta hop-ecotype are very similar, except two setae (D2 and the most posterior abdominal L seta) average slightly longer in C. neglecta hop-ecotype than Colo. violacea. Thus, C. neglecta hop-ecotype is not related to eastern C. neglectamajor. Early stages (from Chimney Gulch, Apex Gulch, Red Rocks): EGG pale bluish-green, becoming greenish-white. FIRST-STAGE LARVA slightly-yellowish cream (slightly yellower when fatter), prothoracic shield cream, D2 short, L3 half-length of other L's; head black. MATURE LARVAE have a darker middorsal band and a darker subdorsal oblique band on prothorax that edge a dark-filled paler triangle (some green larvae have prothorax green on top with a middorsal greenish-white patch), a middorsal darker band (consisting of large square spots on T2-3-A1, anteriorly-directed smaller triangles on A2-6 (or rectangles on A2-3), a variably-shaped spot on A7, a band on A8-10), on each segment a paler dash beside the middorsal band, then a darker slightly oblique streak or dash (sometimes faint, so that a large pale spot is formed of the adjacent pale dashes), then a strongly-oblique pale streak, below it a dark streak (varying to black in the darkest larvae), then a weak pale spot or short dash, a darker area, and a lateral pale band along the larva; head brown. But the overall larval color varies between larvae from yellowish-green to blue-green to green with cream marks and brown middorsal band to brown with cream or yellow markings to brownish-red with cream markings (Table 5); the variation is continuous from the paler to browner larvae, and all the variants except the reddest larvae were reared from Red Rocks in 1973, yellow-green to reddish larvae were reared from Apex Gulch and Chimney Gulch in 1989, but only green larvae were reared from Red Rocks and Apex Gulch in 1987 (probably due to small 1987 sample size). Yellowish-green larvae with whitish marks are most common. Mature C. neglecta hop-ecotype larvae are similar in color pattern to C. lucia-type form violacea, and show the same continuous variation from mostly-green to mostly-brown larvae, so I am not sure that mature larvae differ in color pattern; the small differences between larval variants shown by Tables 4-6 may be due to small sample sizes. Mature larvae are variable, but the variation

in both Celastrina species occurs mostly along one green-to-brown gradient, so Celastrina larvae are much less variable than Strymon melinus larvae. PUPA mottled slightly-reddish brown (on head, thorax and wings, and abdomen, though top of abdomen is usually a little paler), a middorsal dark-brown band on thorax and abdomen (thicker on abdomen), a black spot on shoulder of wing, a subdorsal black spot on T3 (small), A1 (large, adjacent to that on T3), A2 (tiny or absent), A3 (small), A4 (larger, twinned), A5 (large, twinned); A6 (largest, twinned) (some pupae have these subdorsal black spots mostly absent except moderate in size on A1, A5-6); as emergence nears, the eyes and proboscis tip turn black before the rest of pupa. C. neglecta hop-ecotype pupae apparently show a real difference from C. lucia-type form violacea/lucia pupae, because they are more uniformly mottled brown and the wings are slightly more translucent brown (lucia-type pupae have a darker top of thorax contrasting with paler lochrel abdomen & wings), though the difference is not enough to identify all pupae. Pupae hibernate.

Table 5. Mature larvae of Colo. Celastrina neglecta hop-ecotype.

Overall Color	Ground Color	Mid-dorsal Band	Subdorsal & Obliques	Lateral Band	Edge of Laterals
brownish-red & tan (prepupa)	light reddish-brown	dull red	reddish-tan & dark red-brown	reddish-tan	brownish red
red-brown & cream	light brown	red-brown	cream & dark red-brown	tan	light brown
brown & yellow	grainy-brown	maroon-brown	yellow & brown (black below)	yellow	brown
brown & cream	brownish-green	brown	greenish-cream & brown (black below)	greenish-cream	greenish-brown
olive-green, yellow, red-brown	olive green	red-brown	light-yellow & brownish-green	light dull yellow	greenish brown
green, cream, brown	green	maroon-brown	cream and green (dark-green below)	yellowish-cream (maroon-brown at rear of each segment)	green
light-green & brown	light-olive-green	maroon-brown	light-olive-green & brown	brownish-green	tan
light-yellow, maroon-brown	light-olive-green	maroon-brown	light-yellow & light-green (dark-green below)	light-yellow	light-olive-green
green, cream, brown	pale-green	chestnut-brown	cream & tan (dark-green below)	cream	tan
green & white	green	brown-green	white & green	white	light-green
green & pale-green	green	dark-green	pale-green	pale-green	green
blue-green	blue-green	dark-green	light-green & blue-green	tan-green	green

92	green & greenish- yellow	green	green	greenish- yellow (or yellow) & green	greenish- yellow (or yellow)	green
	blue- green & yellow (prepupa?)	blue- green	green	light-yellow & blue-green	light-yellow	blue- green

Celastrina neglecta lupine-ecotype. Electrophoresis done by David M. Wright (pers. comm.) on adults I sent proved that this is the same taxon as Celastrina neglecta hop-ecotype, but I think its host preference differs genetically. Oviposition 11:10 flower buds on lower part of inflorescence (3 other eggs found on flower buds farther up), oviposition 13:20 on tiny 3-mm leaf buds in joint 5 cm from base of inflorescence (3 other eggs found on flower buds of inflorescence), oviposition 14:03 on flower buds, oviposition 14:10 on lower side of big leaflet near base, oviposition 14:11 on tiny leaf buds at base of leaf 4 cm from end and 2 cm below inflorescence (4 other eggs found on this hairy inflorescence), all on Lupinus argenteus var. (white flowers with no banner spot, glabrous plane leaves); no eggs were found on Astragalus flexuosus flower buds; gulch bottoms and lower N-facing slope, Tinytown, Jefferson Co. Colo., June 24, 1990. 13 eggs (11 on flower buds, 2 on underside of leaves near flower buds) found on L. argenteus white var., preovipositions 10:40, 13:39, 13:50; all in gulch or low on N-facing slope, Tinytown, Jefferson Co. Colo., June 25, 1990. Oviposition 15:06, 15 eggs found, all on L. argenteus white var. flower buds; valley bottom, Tinytown, Jefferson Co. Colo., June 26, 1990. 5 eggs found on flower buds of L. argenteus white var.; gulch, Tinytown, Jefferson Co. Colo., June 27, 1990. 1 egg found on L. argenteus white var. flower bud; no eggs found on Physocarpus monoqynus; Tinytown, Jefferson Co. Colo., June 28, 1990. Oviposition 12:22 young flower bud; 13 larvae from 4-12 mm long found on inflorescences (the older larvae on seedy inflor. or on pods), reared to 6 diapausing pupae, 2 black ants seen on one mature larva; all on L. argenteus white var.; Tinytown, Jefferson Co. Colo., July 15, 1990. Oviposition 12:18 L. argenteus white var. flower buds, Tinytown, Jefferson Co. Colo., July 1, 1991. 5 ovipositions (11:35 on inflorescence 1.5 cm long, 11:53 4 mm, 11:55 4 mm, 11:57 & 11:58 8 mm), 14 eggs found (1 on 1 cm young leaf beside 5 mm inf., 4 eggs on 4 cm inf., 1 on 4 mm, 2 on 2 cm, 1 on 2 cm, 4 on 2 cm, 1 on 2 cm), all on young L. argenteus white-var. inflorescences, Tinytown, Jefferson Co. Colo., June 11, 1992. Oviposition 12:17 (on inflor 2 cm long), eggs found (1 on 4 cm inflor., 1 on 3, 4 on 3, 2 on 2, 1 on 2.5, 6 on 2.5, 2 on 3, 4 on 4, 5 on 2.5, 2 on 3, 1 on 3, 3 on 3, 1 on 2, 2 on 3, 2 on 3, 2 on 2, 1 on 2, 1 on 1.5, 2 on 3, 4 on 3, 1 on 2), females refuse to oviposit on older inflor 4 cm on longer, all on L. argenteus (white var.) inflor., Tinytown, Jefferson Co. Colo., June 13, 1992. Oviposition 10:03 inflor. 1.5 cm long (4 other eggs found on it and 1 egg found on 5 mm new leaf just below inflor.), oviposition 10:04 1 cm inflor (3 other eggs found on it and 3 on 1.5-cm new leaf 2 mm away), 1 egg found on 2.5-cm inflor., all on L. argenteus white var., female landed on Stellaria but flew, landed on Anemone canadensis several times but flew; Tinytown, Jefferson Co. Colo., June 17, 1992. Preoviposition, went past Prunus virginiana melanocarpa flowers and landed on Clematis hirsutissima several times but departed, Tinytown, Jefferson Co. Colo., June 2, 1992. 2 ovipositions on Trifolium repens young flower heads (she landed on immature head 3 cm from L. argenteus white var. and laid egg 10:30, ignored 2 more heads, then ovip. 10:47 on head ~12 cm from Lupinus), ~60 T. repens heads searched but no eggs found; oviposition 11:39 on 2 cm L. argenteus white var inflorescence, 11 eggs found on L. argenteus white var. inflor. (3 on 2 cm inf., 5 on 3, 3 on 1.5); Tinytown, Jefferson Co. Colo., June 16, 1992. All these L. argenteus records involve a variety with white-flowers with no banner spot, and plane (non-folded) glabrous (except a few hairs ventrally) leaves widest 2/3-3/4 from base to tip (it is not ingratus, which floras describe as having white flowers but with a banner spot and folded glabrous leaves); this var. is not widespread, but seems to occur on deep valley bottom soil. The usual widespread variety has light blue flowers and leaves V-shaped in cross section that are widest in middle, the leaf uppersides glabrous or sometimes somewhat hairy, and seems to prevail on ridges and S-facing slopes, implying that flower color could possibly be influenced by soil, but the current taxonomic nomenclature of L. argenteus is obviously preliminary. Females seem

to be host-specific to this Lupinus white var., and never showed much interest in any other plant, except for the 2 ovipositions on Trifolium repens very near Lupinus, which is obviously just a rare secondary host; thus C. neglecta lupine-ecotype seems to have genetically adapted to this Lupinus host despite occurring only ~2 km W of where C. neglecta hop-ecotype probably occurs. EGG pale-bluish-green like all Celastrina, becoming greenish-white, sculpturing gives the appearance of conspicuous knobs all over egg in oblique view (each knob resembles an octopus body with ridges radiating outward like arms), but dorsal view shows craters on top (all Celastrina have the same egg sculpturing). FIRST-STAGE LARVA yellowish-cream (yellowish when fatter), with a touch of greenish dorsally (bluish-green on T1), D2 short, L3 short but perhaps longer than lucia-type form violacea, similar to C. neglecta hop-ecotype. HALF-GROWN-LARVA yellowish-cream (heart band darker green, slightly paler edging of heart, 3 oblique paler-green dashes between heart & side, lateral band paler green; or larva cream-green (heart slightly darker), some larvae pale green with cream dashes (beside dark heart & the obliques & lateral band), one larva cream-green with weakly-pink heart-band. MATURE LARVAE (Table 6) more variable than half-grown larvae (like other Celastrina): one larva green with gray heart-band and the usual lines (edging heart, 3 obliques, lateral ridge) are paler green; one larva is also green but differs by having the heart-band brownish-gray (the band's edging and the upper obliques are greenish-cream); four larvae are yellow-green with heart-band reddish-brown, the paler lines yellow-cream (cream edging heart, upper two obliques cream, lower one oblique pale green, lateral ridge cream), and one of the four yellow-green larvae has a dark reddish-brown acute triangle flaring laterally from the top of the front of A1 (one of these five, with green supralateral areas and very creamy obliques beside the heart, appears fairly similar to the most common C. neglecta hop-ecotype form); one larva (prepupa) has the red more widespread on top of body. On average, more larvae are creamy (creamy-green) in color than in other Celastrina ecotypes, esp. half-grown larvae most of which were greenish-cream; however if 100 rather than 10 larvae had been reared, various brown forms etc. may have been found, so I cannot say conclusively that the larvae differ in color from other Celastrina. PUPA brown on head & thorax, warm orange-brown on wings & abdomen, a middorsal brown band (blackish on T1, weak T2, formed of dashes on abdomen), subdorsal blackish spots (small on wing base, small on T3, large on front of A1, in pairs [one above & in front of other] on A2-6 [spots rare on A2], largest on A4-6 where the pairs are fused into one large spot), subspiracular blackish dots on A5 and sometimes A6, (these abdomen spots are small on most pupae but were very large on one pupa which in addition had giant blackish subspiracular patches on A5-7 and blackish dashes on A5-6 just lateral to midventral axis), eyes & antenna clubs blackish-brown; attached to substrate by cremaster and a silk girdle at rear of A1. Pupae the same as C. neglecta hop-ecotype, but some hop-ecotype pupae are orange-brown on front of abdomen and have middorsal brown band usually darker (but only 6 C. neglecta lupine-ecotype pupae were reared so these differences may be just individual variation). C. "lucia-type" form violacea pupae the same, but violacea abdomen much paler yellow-brown. Pupae hibernate.

Table 6. Mature larvae of Colo. C. neglecta lupine-ecotype.

Overall Color	Ground Color	Mid-dorsal Band	Subdorsal & Obliques	Lateral Band	Edge of Laterals
green, faint lines	green	gray	paler-green & green	paler-green	green
green, weak lines, gray heart	green	brownish-gray	greenish-cream (lower obliques green) & green	greenish cream	green
yellow-green, brn heart	yellow-green	red-brown	yellow-cream & olive-green	yellow-cream	yellow-green
green, yellow, red band	green	brownish-red	yellow-cream & olive-green	yellow-cream	green

yellow-green, cream, red	yellow-green	reddish	yellow-cream & yellow-green	yellow-cream	yellow-green
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Glaucopsyche lygdamus oro (Scud.). Ovipositions 9:20 and 9:34, and 12 eggs found on flower buds, 11 eggs found on immature leaves, 8 eggs found on mature leaves, all on Astragalus miser var. oblongifolius (W), Saguache Park, 11000', Saguache Co. Colo., June 24, 1971. Oviposition on unopened flower buds of Astragalus adsurgens var. robustior (W), Mt. Zion, Jefferson Co. Colo., June 11, 1978. Oviposition 11:54 A. a. var. robustior flower bud, Guy Hill, Jefferson Co. Colo., June 15, 1988. 3 eggs found on A. a. var. robustior sepals, S. Table Mtn., Jefferson Co. Colo., May 30, 1991. 2 eggs found A. a. var. robustior stem at inflorescence base and on sepal, Tinytown, Jefferson Co. Colo., June 4, 1992. Ovipositions 13:29, 13:29, 13:57, 14:03, 14:20, 14:20, all on side of flower buds of Astragalus flexuosus, and numerous other eggs found on flower buds of other A. flexuosus plants (9 eggs on one plant alone); females obviously prefer A. flexuosus because they ignored Oxytropis lambertii and Lupinus argenteus and Astragalus drummondii plants here; all Green Mtn., Jefferson Co. Colo., May 18, 1986. Oviposition 13:50 A. flexuosus flower bud, Tinytown, Jefferson Co. Colo., June 1, 1988. Oviposition 9:15 A. flexuosus flower buds, Tinytown, Jefferson Co. Colo., June 3, 1988. Oviposition 10:42 tiny A. flexuosus flower buds, E Box Elder Creek, Arapahoe Co. Colo., June 4, 1988. Oviposition 12:08 on very young A. flexuosus flower buds, Guy Hill, Jefferson Co. Colo., June 8, 1988. Oviposition 11:12 on underside of 3 mm young leaflet next to young A. flexuosus flower buds, Guy Hill, Jefferson Co. Colo., June 9, 1988. Oviposition 13:34 A. flexuosus flower bud, Tinytown, Jefferson Co. Colo., June 2, 1992. Egg pale-bluish-green. Oviposition on unexpanded A. flexuosus leaf 2 mm from 4 mm long budding inflorescence; 4 plants of Astragalus parryi had no eggs on young inflorescences; Tinytown, Jefferson Co. Colo., May 12, 1989. Oviposition 12:25 on underside of tiny unexpanded young leaf next to immature A. flexuosus flower buds, Tinytown, Jefferson Co. Colo., May 18, 1989. Oviposition 9:20 on A. flexuosus flower bud, oviposition 9:32 on Lupinus argenteus flower bud, both laid by one female, Guy Hill, Jefferson Co. Colo., June 27, 1986. 2 eggs found on A. flexuosus sepals, 1 egg found Thermopsis divaricarpa sepal, Tinytown, Jefferson Co. Colo., June 5, 1991. Oviposition 11:12 and 4 eggs found on L. argenteus flower buds, oviposition 11:20 A. flexuosus flower bud, oviposition 11:36 A. a. var. robustior flower bud, Guy Hill, Jefferson Co. Colo., June 10, 1988. 7 eggs found on Oxytropis lamberti flower bud sepals; 4 eggs found on A. flexuosus flower buds; Apex County Park, Jefferson Co. Colo., May 29, 1991. 1.2 cm larva found next to Astragalus agrestis (= dasyglottis) leaf, reared to diapausing pupa (not reared to adult, but pupal diapause and color pattern of larva indicate that it was lygdamus and not Strymon melinus), Guy Hill, Jefferson Co. Colo., June 19, 1988. Oviposition 10:25 among Astragalus bisulcatus flower buds; Horsetooth Res., Larimer Co. Colo. May 23, 1990. Oviposition on L. argenteus, Chautauqua Mesa, Boulder Co. Colo., May 1965. Oviposition 9:30 on flower buds of L. argenteus and 2 other eggs found on buds, Red Rocks, Jefferson Co. Colo., May 22, 1977. Oviposition 11:32 very young flower buds of L. argenteus, Chimney Gulch, Jefferson Co. Colo., June 28, 1978. Oviposition 8:38 on flower bud of L. argenteus, Green Mtn., Jefferson Co. Colo., June 12, 1980. Oviposition 11:35 and 5 other eggs found, all on L. argenteus flower buds, Guy Hill, Jefferson Co. Colo., June 19, 1988. 6 eggs found on flower buds, 1 on leaf, of L. argenteus, Box Elder Creek, Elbert Co. Colo., May 26, 1991. 1 egg found among L. argenteus flowers, Box Elder Creek, Arapahoe Co. Colo., May 28, 1991. 2 eggs found on L. argenteus flower buds, Mt. Vernon Historic Site, Jefferson Co. Colo., June 4, 1991. 10 eggs found on L. argenteus flower buds, Lookout Mtn., Jefferson Co. Colo., June 6, 1991. Oviposition underside of Thermopsis divaricarpa leaf, Blackman Trail, Gilpin Co. Colo., June 19, 1977. Oviposition 11:55 on T. divaricarpa flower buds on hilltop, Lookout Mtn., Jefferson Co. Colo., May 17, 1979. 1 eggshell found on T. divaricarpa sepal, Wheatridge, Jefferson Co. Colo., June 4, 1991. Oviposition 12:12 among Medicago sativa flower buds, after landing on Glycyrrhiza lepidota flower buds many times but refusing to lay, she previously landed on Trifolium pratense flower but no eggs were found on T. pratense flowers, Wheatridge, Jefferson Co. Colo., June 29, 1989. HOSTPLANTS: Astragalus flexuosus and A. miser var. oblongifolius are both very popular as is Lupinus argenteus; other legumes have fewer records perhaps because they are less common (Astragalus adsurgens var. robustior, A. agrestis, A. bisulcatus, Oxytropis lamberti, Thermopsis

divaricarpa, Medicago sativa) or perhaps because some are less popular; Glycyrrhiza lepidota and Trifolium pratense are probably not preferred.

Obviously larvae eat flower-buds-fruits of numerous Fabaceae. EGG whitish-green. FIRST-STAGE LARVA pale greenish-yellow; head black. Mature larva & pupa (Guy Hill): MATURE LARVA ground color pale-green (but overall appearance variegated greenish-white with maroon middorsal band because of numerous cream markings), a middorsal narrow maroon band (widest anteriorly, brown on A7-10), on each segment a cream band edging middorsal band, a faint greenish-cream dash (forming the inside of an anteriorly-directed cream check mark composed of the cream areas described last and next), an oblique cream dash (forming the long arm of the check mark), a green streak just beneath it, a less-oblique narrower cream dash, a diffuse broad cream band, a greenish-cream band above and below a wide lateral cream band, body covered with white setae shorter than those of Strymon melinus. PUPA pale brown except abdomen pale-yellow-brown, with scattered tiny brown spots, a middorsal black line on thorax (widest on front of pronotum), a middorsal band on abdomen composed of brown spots, pronotum edged laterally with black, a weak brown subdorsal spot on front of T2, A1, A4, A5, attached by cremaster & silk girdle. Pupae hibernate.

Glauconycta piasus daunia (Edw.). Oviposition 8:51 of 2 eggs together on side of flower bud of Lupinus argenteus, Green Mtn., Jefferson Co. Colo., June 12, 1980. Ovipositions 11:30, 11:34 on flower buds of L. argenteus, Chimney Gulch, Jefferson Co. Colo., July 1, 1978. Oviposition L. argenteus, Chautauqua Mesa, Boulder Co. Colo., May 1965. Oviposition 11:01 2 eggs on L. argenteus flower buds, Guy Hill, Jefferson Co. Colo., June 9, 1988. Ovipositions 9:38 & 10:05 tucked between flower buds, and ~30 eggs found between flower buds (some inflorescences have up to 5 eggs), all on L. argenteus, the female ignored Astragalus adsurgens var. robustus, Guy Hill, Jefferson Co. Colo., June 27, 1988. Oviposition 14:30 between L. argenteus flower buds; Crawford Hill, Jefferson Co. Colo., July 1, 1990. 2 dead eggs (piasus?--had coarser bumps than G. lygdamus) found on Lupinus argenteus flower buds, Apex County Park, Jefferson Co. Colo., May 29, 1991. Adults associated with Lupinus prunophilus (a few L. caudatus also present), SW Hot Sulfur Springs, Grand Co. Colo., June 24, 1989. EGG pale-greenish-white. 1ST-STAGE-LARVA greenish-cream with long white hair; head black.

Philotes sonorensis (F. & F.). Ten eggs on Dudleya cymosa, Lang Crossing, South Yuba River, Nevada Co. Calif., April 27-28, 1978, Ralph Wells, J. Scott and Oakley Shields. Two eggs on D. cymosa, Blue Ravine, SW Allegheny, Sierra Co. Calif., May 12, 1974, Ralph Wells, J. Scott.

Euphilotes battoides centralis. Although the following are only association records, the intense restriction of adults of Euphilotes to their larval hostplants makes association records very useful. Adults associated with Eriogonum jamesii var. jamesii throughout Pueblo, Custer, Fremont, Chaffee, and Saguache Cos. Colo., which is surely the only hostplant there. Adults near centralis assoc. with E. umbellatum var. subaridum (R), top of Westgard Pass, Inyo Co. Calif., July 7, 1974.

Euphilotes battoides comstocki (Shields). Adults assoc. with Eriogonum umbellatum var. furcosum (R), Big Pine Meadow, Tulare Co. Calif., July 7, 1974.

Euphilotes battoides ellisii (Shields). Adults assoc. with Eriogonum corymbosum var. orbiculatum (R), NE Gateway, Mesa Co. Colo., Aug. 23, 1977.

Euphilotes battoides fall-flying ssp. This ssp. has the host of ellisii and resembles it except the unh orange band is very narrow as in the fall-flying Mojave Desert ssp. Adults assoc. with Eriogonum corymbosum var. velutinum (R), E Aztec, San Juan Co. New Mex., Aug. 27, 1977.

Euphilotes bernardino bernardino (B. & McD.). Adults assoc. with Eriogonum fasciculatum var. polifolium (R), Red Rock Can., El Paso Mts., Kern Co. Calif., May 5, 1974. E. bernardino, which includes E. b. martini (Matt.), is a distinct species from E. battoides (work of Gordon Pratt).

Euphilotes enoptes enoptes (Bdv.). Adults associated with Eriogonum nudum var. nudum (R), Anthony Peak Lookout, Mendocino Co. Calif., June 29, 1974. Adults associated with E. n. var. nudum (R), Big Hill Lookout, El Dorado Co. Calif., June 30, 1974.

Euphilotes ancilla (B. & McD.). Oviposition 10:32 in flower of Eriogonum umbellatum var. umbellatum (W), Red Rocks, Jefferson Co. Colo., July 7, 1978. Oviposition 9:45 on inner surface of E. u. var. umbellatum petal, Green Mtn., Jefferson Co. Colo., June 15, 1985. Preoviposition 13:40 E. u. var. umbellatum flowers, Chimney Gulch, Jefferson Co. Colo., June 28, 1978. Oviposition 11:25 inside E. u. var. umbellatum Torr. flower, Tinytown, Jefferson Co. Colo., July 22, 1987. Oviposition 15:30 three eggs inside corolla of E. u. var. umbellatum flowers; E. u. var. umbellatum is probably the main hostplant here because it is in the flower bud stage now when adults are common, whereas Eriogonum subalpinum

growing intermixed is flowering strongly; SW Hot Sulphur Springs, Grand Co. Colo., June 30, 1989. Oviposition 12:12 on petal inside E. u. var. umbellatum flower; Crawford Gulch, Jefferson Co. Colo., July 5, 1990. Adults associated with E. u. var. umbellatum (no other Eriogonum present); Dory Hill, Gilpin Co. Colo., July 8, 1990. Adults associated with E. u. var. umbellatum throughout Larimer, Boulder, Jefferson, Gilpin, and Grand Cos. Colo. Adults associated with E. subalpinum (no umbels around stems of my specimen; previously misidentified as heracleoides var. heracleoides by J. Reveal, though possibly the specimen sent to him was heracleoides), Talamantes Creek, Moffat Co. Colo., July 8, 1972. EGG whitish-green. 1ST-STAGE-LARVA pale-yellow; head black.

Euphilotes rita rita (B. & McD.). Adults associated with Eriogonum wrightii var. wrightii (det James L. Reveal), 3 mi. W. Alma, Catron Co. New Mex., Aug. 9, 1986.

Euphilotes rita coloradensis (Mattoni). Oviposition inside flower of Eriogonum effusum, 1 mi. S Silver Cliffe, Custer Co. Colo., Aug. 7, 1965. Larva (mostly red in color, matching the old flowers and fruits) found on E. effusum flowers raised to adult, Owl Creek, Central Plains Experiment Station, Weld Co. Colo., Sept. 7, 1976 (pupa hibernated). Adults near coloradensis associated with Eriogonum rotundifolium (R), sand dunes 5 mi. NE San Felipe Pueblo, Sandoval Co. New Mex., Sept. 9, 1977. Adults associated with Eriogonum flavum var. flavum (this plant very common, but a few E. effusum occurred), Terry Road Exit I-25, Laramie Co. Wyo., June 23, 1986.

Euphilotes rita emmeli (Shields). Adults associated with Eriogonum leptocladon var. leptocladon (R), NW Moab, Grand Co. Utah, Aug. 24, 1977. Adults associated with E. leptocladon var. ramosissimum (R), sand dunes E of Shiprock, San Juan Co. New Mex., Sept. 5, 1977. Adults associated with E. l. var. ramosissimum (W), stateline SE Aneth, Montezuma Co. Colo., Sept. 6, 1978. Adults associated with E. l. var. ramosissimum, dunes N of Rock Point Trading Post, Apache Co. Ariz. Aug. 19, 1980.

Euphilotes spaldingi pinjuna Scott. Adults associated with Eriogonum racemosum (R), Shilling's Spring, Conejos Co. Colo., July 9, 1967, and Terrace Res., Conejos Co. Colo., July 8-9, 1967, and Animas River 7.2 mi. N New Mex. line, La Plata Co. Colo., Aug. 27, 1977.

Plebejus glandon rustica (Edw.). Oviposition 12:08 and 25 eggs (21 on underside of leaves, 1 on top of leaf, 4 on calyx) found on Androsace septentrionalis, NE of Salida 8500', Chaffee Co. Colo., July 12, 1971. Oviposition 14:25 on inflorescence of A. septentrionalis, Central City, Gilpin Co. Colo., June 23, 1973. Oviposition 9:30 on bract at base of umbel of A. septentrionalis, Loveland Pass, Summit Co. Colo., July 19, 1977. Oviposition 11:30 on lower leaf and two eggs found on bases of lower leaves of A. septentrionalis, West Chicago Creek 9200', Clear Creek Co. Colo., July 31, 1977. Oviposition 10:37 and 5 other eggs found (4 eggs on calyx and 2 on underside of leaves) all on A. septentrionalis var. puberulenta, Loveland Pass, Summit Co. Colo., July 25, 1978. Oviposition 11:24 on base of flower bud sepal, 2 eggs found on underside of basal leaf, 1 egg found on top of base of basal leaf, 1 egg found on shoot at junction of two flower pedicels, 1 egg found on edge of umbel-subtending bract, all on A. s. var. puberulenta, Loveland Pass, Clear Creek Co., Colo., July 22, 1989. Preoviposition 11:10 near A. septentrionalis; Tinytown, Jefferson Co. Colo., June 21, 1990. Eggshell found on A. septentrionalis var. subulifera, NW-facing slope, Tinytown, Jefferson Co. Colo., July 4, 1991. Two ovipositions on underside of leaves of Androsace chamaejasme carinata, Hermit Pass, Custer Co. Colo., Aug. 1, 1971. Oviposition 10:59 on side of Carex rupestris drummondiana stem base 3 mm from A. c. carinata seedling rosette; Mt. Bross, 13,500', Park Co. Colo., July 17, 1990. Amazingly, the butterfly is able to mature eating the very tiny Androsace plant. EGG white. FIRST-STAGE LARVA pale yellow-tan (orangish-tan on rear); pronotum light brown, suranal plate brown; head black.

Plebejus idas anna (Edw.). Oviposition 14:00 Lotus oblongifolius var. nevadensis (C), Scott Camp Creek, SW of Shasta City, Siskiyou Co. Calif., Aug. 3, 1974.

Plebejus idas atrapraetextus (Field) ("sublivens" Nab.). Adults common about Astragalus alpinus (W), N Weminuche Pass, 10500', Hinsdale Co. Colo., July 31, 1972, and also at Slumgullion Pass, Hinsdale Co. Colo., July 30, 1972. 2 males found near Lupinus argenteus var. tenellus, SW Wetterhorn Peak, 11500', Hinsdale Co. Colo., July 20, 1980.

Plebejus melissa melissa (Edw.). Oviposition 9:55 on underside of leaf of Astragalus flexuosus (W), Chimney Gulch, Jefferson Co. Colo., July 17, 1978. Oviposition 12:28 on dead grass touching stem of A. flexuosus (W), Chimney Gulch, June 28, 1978. Oviposition 12:44 on top of leaflet next to stem (after walking from a flower down the stem) of A. flexuosus, Green Mtn., Jefferson Co.

Colo., June 19, 1985. Oviposition 12:15 under stem, after crawling 2/3 way down A. flexuosus plant, S. Table Mtn., Jefferson Co. Colo., May 30, 1991. Mature larva found below A. flexuosus, Tinytown, Jefferson Co. Colo., July 3, 1991. Eggshell found on underside of A. flexuosus leaf, egg found on underside of leaf of Astragalus racemosus, W end South Table Mtn., Jefferson Co. Colo., Oct 5, 1987. Preoviposition, she landed on A. flexuosus and crawled down stem to ground several times, the same female fed on Psoralea (Psoralidium) tenuiflora flowers 4X but showed no interest in oviposition, N Golden, Jefferson Co. Colo., Aug. 8, 1989. Oviposition 14:03 on underside of A. flexuosus leaflet base, oviposition 13:30 on Astragalus adsurgens var. robustior stem, in both she landed on leaf on branch tip and crawled down stem to lay, Guy Hill, Jefferson Co. Colo., June 8, 1988. Ovipositions 13:12, 13:32, 13:39 and three other eggs found (on underside of leaves except 1 on top, 1 on litter below plant) on A. a. var. robustior, Green Mtn., Jefferson Co. Colo., Sept. 4, 1984. A female tested but rejected A. a. var. robustior 3 times for oviposition, Cherry Gulch, Jefferson Co. Colo., Aug. 17, 1987. Preoviposition 9:55 A. a. var. robustior, Guy Hill, Jefferson Co. Colo., June 10, 1988. Oviposition 9:49 2 eggs on underside of A. a. var. robustior leaf and on underside of grass blade after crawling down stems, Guy Hill, Jefferson Co. Colo., June 17, 1988. 5 eggs found (1 on green grass next to stem) of A. a. var. robustior stem bases, 2 eggs found Astragalus drummondii stem bases; Green Mtn., Jefferson Co. Colo., Aug. 28, 1990. Oviposition on hairy stem of A. drummondii (previously misidentified as Oxytropis sericea) near the ground, and 3 other eggs found there, NW Gardner, Huerfano Co. Colo., June 16, 1973. Six eggs found on A. drummondii, Central Plains Experiment Station, Weld Co. Colo., Sept. 7, 1976. Oviposition 10:47 on stem of A. drummondii after landing on leaf and walking down stem 3 cm., Green Mtn., Jefferson Co. Colo., June 7, 1985. Two eggs laid 10:40 on dead twig and grass stem beneath A. drummondii (G), plus 32 eggs found on debris beneath plants, 8 eggs on stems several cm above ground, all on A. drummondii, Austin Bluffs near Pulpit Rock, NE Colorado Springs, El Paso Co. Colo., Sept. 6, 1971; one egg on ground beneath, 1 egg on lower stem, of Lupinus argenteus, Austin Bluffs, Sept. 6, 1971 (L. argenteus plants were commoner than A. drummondii here but few eggs were found on L. argenteus, indicating that females prefer A. drummondii for oviposition); all eggs were placed near the ground, and ovipositing females land on leaves then crawl down the stem to the base to oviposit. Oviposition 9:50 on underside of A. drummondii leaf after walking down stem, Green Mtn., Jefferson Co. Colo., June 3, 1986. Adults associated with A. drummondii; Horsetooth Res., Larimer Co. Colo. May 26, 1990. 3 eggs found on Astragalus parryi (2 on lower leaf undersides, 1 on lower stem underside); 1 egg found on A. flexuosus stem base; Tinytown, Jefferson Co. Colo., Aug. 30, 1990. 3 eggs found (1 basal leaf underside, 2 on lower stems) of A. parryi; Red Rocks, Jefferson Co. Colo., Sept. 4, 1990. Fifteen eggs laid on Astragalus miser var. oblongifolius (W), E Alamosa, Alamosa Co. Colo., Aug. 16, 1974. Egg found on 2-mm-wide stem base of Astragalus halli; mouth Beaver Creek, Grand Co. Colo., July 11, 1990. Adults associated with Astragalus bisulcatus, Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 9, 1987. 6 eggs found on A. bisulcatus stem bases; N Bear Creek Res., Jefferson Co. Colo., Sept. 24, 1990. Oviposition 11:42 on Thlaspi arvense seedling after crawling down stem of A. bisulcatus, W Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 10, 1987. Oviposition 11:30, she crawled down stem and laid on underside of leaflet 1/3 up from base to top of Astragalus agrestis (= dasygloTTis), Guy Hill, Jefferson Co. Colo., June 9, 1988. Larva on flowers of Oxytropis sericea raised to adult Central Plains Experiment Station, July 1976, J. Scott and David Wagner. Oviposition 11:15 on twig on ground after walking down stem of Medicago sativa, 14 mi. N Camp Cottonwood, Montezuma Can., San Juan Co. Utah, Aug. 25, 1977. Oviposition 12:20, she crawled down stem of two young M. sativa plants and bent abdomen on stem base of both and laid 2 eggs on second plant (1 egg on dead horizontal grass blade ~5 mm from stem base, 1 egg on green stem base); Wheatridge, Jefferson Co. Colo., Aug. 11, 1990. Oviposition 13:00 on underside of leaf of Eriogonum subalpinum (= E. umbellatum var. major) (R), Keystone Gulch, Summit Co. Colo., Aug. 6-7-8, 1977 Glenn R. Scott (this is apparently an error in oviposition by the female, but is interesting nonetheless, because several other Lycaenidae [Callophrys affinis, Plebejus acmon] eat both Fabaceae and Eriogonum as larvae). Adults associated with Sphaerophysa salsula (W) (this plant resembles Astragalus with red flowers, inflated pods, and linear branches, and was the only possible host where P. melissa was very common, so is surely the hostplant here), 9.7 mi. S. junction highways 285 and 17, Saguache Co. Colo., Aug. 17, 1986. 1 egg and 2 eggshells found (2 on stem base, 1 on green grass blade ~1-2 cm from stem) on S. salsula, 6 larvae (2/3-grown to mature) swept from S. salsula (3 larvae parasitized but 1

female reared to adult); 5 mi. N Moffat, Saguache Co. Colo., Aug. 22, 1990. Oviposition 13:26 Trifolium fragiferum, she landed on leaf and crawled down stem and laid egg near ground, Barr Lake, Adams Co. Colo., Aug. 27, 1988. Oviposition? on T. fragiferum, she bent abdomen down into litter below leaves for ~2 sec but I could not find an egg, Barr Lake, Adams Co. Colo., Sept. 25, 1989. Adults associated with T. fragiferum, Barr Lake, Adams Co. Colo., Aug. 23, 1989. Oviposition 13:19 she crawled down T. fragiferum & laid egg under Taraxacum officinale leaf beside it, 2 cm above ground; Barr Lake, Adams Co. Colo., Aug. 30, 1991. Egg (probably P. melissa, sucked dry by predator) found on Lupinus caudatus stem near plant base, NE Hayden, Routt Co. Colo., July 6, 1989. Egg found on Lupinus prunophilus trunk 4-mm-wide ~2-3 cm above ground; SSW Hot Sulfur Springs, Grand Co. Colo., July 11, 1990. Oviposition 11:40, female crawled down stem and laid egg on tiny leaftop near base of Melilotus officinalis seedling; N Bear Creek Res., Jefferson Co. Colo., Oct. 1, 1990. Oviposition 13:25 on dead grass blade at base, & 1 egg found on leaf upperside, both on M. officinalis (many plants searched); 9 eggs (3 stem base, 6 leaf undersides mostly of seedlings) found on Astragalus bisulcatus (only ~6 plants searched); no eggs found on Medicago lupulina despite many searched; N Bear Creek Res., Jefferson Co. Colo., Oct. 4, 1990. HOSTPLANTS: Astragalus drummondii is obviously very popular; A. bisulcatus, A. miser var. oblongifolius, A. adsurgens var. robustior, and Sphaerophysa salsula, Astragalus flexuosus, A. parryi are less popular; other hosts are probably not preferred (except the following three Astragalus probably have few hosts because they are less common) including Medicago sativa, Melilotus officinalis, Trifolium fragiferum, Astragalus racemosus, A. halli, A. agrestis, Oxytropis sericea, Lupinus argenteus, L. caudatus, L. prunophilus. Lupinus is not preferred, and Medicago lupulina may be shunned. Eggs hibernate. EGG white. MATURE LARVA green with numerous tiny white hairs, heart dark-green edged by a greenish-cream line, three faint oblique (angled downward posteriorly) dashes, a lateral strong yellowish-white line. PUPA green, abdomen yellowish-green, outer half of wings tan, head and abdomen near cremaster tan-green.

Plebejus melissa form or ssp. annetta Nab. (annetta has unh orange spots slightly smaller than lowland ssp. melissa; if the Calif. and Utah populations are genetically distinct, the Calif. Sierra form would be fridayi F. Cherm. if the types of fridayi were from high altitude). Oviposition 11:30 Astragalus whitneyi (M), peak top SE of Sonora Pass, alpine zone, Mono Co. Calif., Aug. 25, 1974.

Plebejus saepiolus whitmeri Brown. Oviposition 8:25 on flower of Trifolium parryi (W), Loveland Pass, Summit Co. Colo., July 19, 1977. Three ovipositions on T. parryi (W), Loveland Pass, Summit Co. Colo., July 28, 1978. Oviposition 9:29 Trifolium dasyphyllum sepal sheath between flowers, Loveland Pass, Summit Co. Colo., Aug 2, 1988. 3 eggs found on side of calyx within T. dasyphyllum heads, Loveland Pass, Summit Co. Colo., July 23, 1988. Oviposition 8:07 on base of Trifolium repens flower, Toll Ranch, Gilpin Co. Colo., July 27, 1977. Adults associated with T. repens, NE Mt. Judge, Clear Creek Co. Colo., July 24, 28, & 31, 1987. Adults associated with T. repens, Guy Gulch NW Guy Hill, Jefferson Co. Colo., July 30, 1987. Oviposition two eggs 10:45 on flowers of T. repens, N fork Clear Creek, Gilpin Co. Colo., July 2, 1978. 1 egg found on flower pedicel, 1 egg found on sepal lobe, both on Astragalus alpinus, only one other inflorescence of A. alpinus seen so it may be preferred because ~10 Trifolium repens inflorescences nearby had no eggs, Eisenhower Tunnel, Summit Co. Colo., Aug. 15, 1988. Egg found inside A. alpinus sepal lobe, Caribou bog, Boulder Co. Colo., July 2, 1989. Adults associated with A. alpinus (no Trifolium present except a few T. pratense); Dory Hill, Gilpin Co. Colo., July 8, 1990. Adults associated with A. alpinus, Golden Gate Can. State Park, Gilpin Co. Colo., July 25, 1990. Adults associated with Astragalus agrestis (= dasygloTTis) (W) (this plant has dark-blue flower clusters and vaguely resembles Trifolium), females were watched for an hour or so but no ovipositions seen, no Trifolium seen at this locality, hillside at Guy Hill, Jefferson Co. Colo., June 25, 1986, June 18, 1992. Oviposition 11:39 on petal just under base of sepal lobe, oviposition 13:31 inside sepal lobe next to petal, both on A. agrestis, Guy Hill, Jefferson Co. Colo., June 8, 1988. Oviposition 10:56 petal under sepal lobe A. agrestis, Guy Hill, Jefferson Co. Colo., June 9, 1988. Oviposition 8:48 2 eggs on petals under sepal lobes, oviposition 9:00 petal under sepal lobe, oviposition 10:02 side of calyx between two flowers, oviposition 11:44 petal under sepal lobe, oviposition 14:16 inside sepal lobe, all on A. agrestis, Guy Hill, Jefferson Co. Colo., June 10, 1988. Oviposition 11:51 2 eggs on petals under sepal lobes A. agrestis, Guy Hill, Jefferson Co. Colo., June 13, 1988. Oviposition 11:45 under sepal base, 1 egg found on petal under petal lobe, oviposition 11:46 2 eggs on petals under base of petal lobes, all A. agrestis, Guy Hill, Jefferson Co.

Colo., June 14, 1988. Oviposition 16:38 petal under sepal lobe, 4 other eggs found on petals under sepal lobe, 1 other egg found under sepal lobe, all on A. agrestis, Guy Hill, Jefferson Co. Colo., June 16, 1988. Oviposition 15:09 under A. agrestis sepal lobe, Guy Hill, Jefferson Co. Colo., June 24, 1988. 6 eggs found on A. agrestis flowers (4 under a sepal lobe glued to petal, 2 tucked under a petal just above sepal lobe), Green Mtn., Jefferson Co. Colo., June 22, 1989. Egg found on side of A. agrestis calyx, E Mother Cabrini Shrine, Jefferson Co. Colo., June 15, 1992. Preoviposition A. agrestis and egg found under sepal lobe, Crawford Gulch, Jefferson Co. Colo., June 10, 1992.

HOSTPLANTS. A. agrestis has the inflorescence in a sphere, which perhaps tricks the female into thinking it is Trifolium; no Trifolium occur at Guy Hill. A. alpinus also has the inflorescence in a sphere, though the sphere is not as compact as that of A. agrestis. A. (Euastragalus) agrestis and A. (Atelophragma) alpinus are in different subgenera, so it would seem that their spherical inflorescence (rather than biochemical similarity to Trifolium) tricks P. saepiolus to lay on them; whatever the mechanism, they are popular, even preferred, hostplants where they occur. Most foothills to lower montane zone populations are widespread on slopes and swales associated with A. agrestis (Green Mtn. and Guy Hill, Jefferson Co.), although one population on the plains (creek E Marshall, Boulder Co.) is associated with Trifolium repens, (1 female caught in Lakewood, ~5 miles E of the mountains, Jefferson Co. Colo., June 7, 1980, had unknown association); upper montane and subalpine zone populations occur in meadows and slopes on Astragalus alpinus; on moist alpine tundra, adults are widespread because several cushion-plant Trifolium are widespread there. EGG bluish-green.

Plebejus saepiolus insulanus Blackm. 1 egg and 1 eggshell found on Astragalus alpinus sepals, S Blue River town, Summit Co. Colo., July 1, 1988. Adults associated with A. alpinus, Silver Creek, Hinsdale Co., Colo., July 17, 1988. 2 eggs found between A. alpinus petals and sepal lobes, W Tabernash, Grand Co. Colo., June 28, 1989. Egg found on underside of A. alpinus sepal lobe; Fraser, Grand Co. Colo., July 31, 1990. 30 eggs found on Astragalus agrestis flowers (most found under sepal lobes, some tucked between petal bases) (12 of the 30 were found on one flower head), 1 egg found between Trifolium repens flowers, 1 egg found between Trifolium pratense petals; obviously A. agrestis is the favorite host here because eggs were very easy to find on it, difficult to find on Trifolium; 1/2 mi. N Silverthorne, Summit Co. Colo., July 3, 1989. Evidently the host-specificity is the same as ssp. whitmeri. FIRST-STAGE LARVA pale yellowish-cream, after feeding becoming greenish inside; prothoracic shield and head chitin-brown.

Plebejus icarioides pembina (Edw.) (= lycea [Edw.]). 30 eggs found on leaves of Lupinus plattensis (F), Central Plains Experimental Range, Weld Co. Colo., June 1976. Adults associated with L. plattensis, Terry Road Exit I-25, Laramie Co. Wyo., June 23, 1986. Two eggs on top of leaves, 1 egg on side of flower bud (eggs identical to eggs dissected from female), of Lupinus argenteus, Chimney Gulch, Jefferson Co. Colo., July 1, 1978. Oviposition 12:22 on top of leaf of L. argenteus, Golden Gate Can., Jefferson Co. Colo., July 8, 1978. Oviposition 10:08 on underside of L. argenteus leaf, oviposition 10:09 on grass blade beside L. argenteus, another egg found on underside of same grass blade, Red Rocks, Jefferson Co. Colo., June 20, 1984. Oviposition 9:53 on side of young terminal flower bud of L. argenteus, Shingle Creek, Jefferson Co. Colo., July 23, 1984. Oviposition 10:48 on side of dry folded leaf of L. argenteus, Genesee Park, Jefferson Co. Colo., Aug. 5, 1984. Oviposition 10:34 on flower bud, another egg found nearby, oviposition 11:38 on top of leaf bud, all on L. argenteus, Green Mtn., Jefferson Co. Colo., June 8, 1985. Oviposition 11:35 on underside of L. argenteus leaf, Corwina Park, Jefferson Co. Colo., July 13, 1985. Oviposition 15:12 on underside of leaf petiole of L. argenteus, Guy Hill, Jefferson Co. Colo., June 25, 1986. Oviposition 12:45 on grass next to L. argenteus leaf, Guy Hill, Jefferson Co. Colo., June 27, 1986. Preoviposition 9:40 L. argenteus, Corwina Park, Jefferson Co. Colo., July 4, 1986. Adults associated with L. argenteus NW Limon, Elbert Co. Colo., Aug. 7, 1989. Egg found on Lupinus argenteus var. (white flowers with no banner spot, glabrous plane leaves; not ssp. ingratus, which has white flowers but has a banner spot and folded glabrous leaves) leaf upperside; Tinytown, Jefferson Co. Colo., June 26, 1990. Oviposition 12:52 on side of L. argenteus var. (white flowers no banner spot, glabrous plane leaves) leaflet; Tinytown, Jefferson Co. Colo., June 28, 1990. 6 eggs found on L. argenteus var. (white flowers no banner spot, glabrous plane leaves) (2 on leaf upperside, 2 on big pods, 1 on little pod, 1 on inflorescence rachis); Tinytown, Jefferson Co. Colo., July 15, 1990. 1 egg found under leaf, 1 on flower bud, both of L. argenteus, Box Elder Creek, Elbert Co. Colo., May 26, 1991. Oviposition 12:43 L. argenteus leaf top of 8-cm-tall plant, Delbert

100. Rd., Smoky Hill Road, Arapahoe Co. Colo., May 19, 1992. Oviposition 12:43 L. argenteus leaf top, Smoky Hill Rd., Arapahoe Co. Colo., May 19, 1992. Adults associated with L. argenteus rubricaulis, Keystone Gulch, Summit Co. Colo., Aug. 6, 1977, and Piney Creek 10500', Eagle Co. Colo., Aug. 16, 1973 (females have bluer ups at both sites). Adults associated with Lupinus parviflorus floribundus (previously misidentified as L. ammophilus), Texas Creek, Mineral Co. Colo., Aug. 21, 1979. Oviposition 11:45 on Lupinus prunophilus (L. prunophilus was formerly lumped into L. ammophilus) leaf underside, SW Hot Sulfur Springs, Grand Co. Colo., June 24, 1989. Oviposition 14:40 and 2 other eggs found (2 on underside, 1 on upperside of leaves) on L. prunophilus, SW Hot Sulfur Springs, Grand Co. Colo., June 30, 1989. 1 egg found on top of L. prunophilus leaflet tip; SSW Hot Sulfur Springs, Grand Co. Colo., July 4, 1990. Oviposition 10:04 two eggs on underside of Lupinus caudatus leaf, NE Hayden, Routt Co. Colo., July 6, 1989. Oviposition 9:30 on L. caudatus (formerly misidentified as L. argenteus) leaf, 1 mi N Dillon, Summit Co. Colo., July 15, 1985. Adults associated with L. caudatus, E Box Elder Creek, Arapahoe Co. Colo., Aug. 8, 1973, and many later years. L. argenteus is the main host in the Colo. eastern slope (adults are associated with it in Jefferson, Boulder, Custer, Saguache, Elbert, Eagle Cos. Colo., and Rio Arriba Co. New Mex.), L. argenteus, L. plattensis, and L. caudatus are eaten on the plains, and many other species are eaten in the mountains. EGG greenish-white.

Plebejus shasta shasta (Edw.). Oviposition Astragalus whitneyi (M), Sonora Pass, Mono Co. Calif., Aug. 25, 1974.

Plebejus shasta pitkinensis (F.). Oviposition Trifolium dasyphyllum (G), Baldy Peak, Custer Co. Colo., July 29, 1970. Oviposition 11:05 on leaf petiole of a small Oreoxis alpina (Apiaceae) plant growing within a 10-cm wide T. dasyphyllum plant, Loveland Pass, Summit Co. Colo., Aug. 5, 1985; egg failed to hatch, evidently diapausing. Ovipositions 11:13-11:25 four eggs on leaves of Trifolium nanum (W), Loveland Pass, Summit Co. Colo., July 25, 1978. Oviposition 10:37 on leaf underside of Potentilla prob. uniflora (leaf upperside dark-green, leaf underside white) growing in T. nanum cushion plant, Loveland Pass, Clear Creek Co., Colo., July 20, 1989. One solid-green larva attached with silk girdle beneath rock raised to adult, Loveland Pass, July 15, 1980. Three prepupae and 9 pupae on underside of rocks, Uncompahgre Peak, Hinsdale Co. Colo., 18, July 1980. Eggs evidently hibernate, and Emmel & Shields (1980) reported that nearly mature larvae of ssp. shasta hibernate; thus high altitude shasta populations are apparently biennial, hibernating as eggs the first winter, then as nearly mature larvae the second winter. EGG slightly-greenish white. Larva/pupa from Uncompahgre Peak: MATURE LARVA (prepupa) dark-green, with black subdorsal spots on abdomen. PUPA greenish-tan, top of thorax green or greenish-tan, abdomen greenish-cream or pale-yellow, head and end of abdomen tan, outer part of wings sometimes tan, a middorsal brown band (narrow and weak on thorax).

Plebejus shasta minnehaha (Scud.). Oviposition 10:20 on underside of leaf petiole of Astragalus spatulatus, egg diapaused, Terry Road Exit of I-25, Laramie Co. Wyo., July 2, 1985. Oviposition 11:29 A. spatulatus (W) leaf underside, egg diapaused, Terry Road Exit I-25, Laramie Co. Wyo., June 23, 1986. Adults assoc. with A. spatulatus (F), Central Plains Experiment Station, Weld Co. Colo., June 1976. Adults assoc. A. spatulatus (W), 8 mi. NE Harrison, Sioux Co. Nebraska, June 21, 1986. Eggs hibernate, giving this lowland ssp. an annual life cycle, although perhaps it is also biennial, the nearly-mature larva hibernating during the second winter.

Plebejus acmon acmon (Westw. & Hew.). Oviposition Lotus oblongifolius var. nevadensis (C), Cottonwood Glade, 6000', Glenn Co. Calif., June 16, 1974 John Lane and J. Scott. Assoc. with E. lobbiai var. robustum (R), SE Virginia City, Storey Co. Nev., June 15, 1972.

Plebejus acmon texanus Gdp. Oviposition 12:52 on side of Eriogonum lonchophyllum flower bud calyx, Bandimere Speedway NE Morrison, Jefferson Co. Colo., Aug. 10, 1984. 1 larva (1 cm long) found on E. lonchophyllum flowers, later pupated, Bandimere Speedway NE Morrison, Jefferson Co. Colo., Oct. 8, 1987. Adults associated with E. lonchophyllum, Bandimere Speedway NE Morrison, Jefferson Co. Colo., Aug. 31, Sept. 18, 22, 1987. (Note: freeway W-470 construction here in 1988-89 destroyed all but a few individuals of the entire E. lonchophyllum population occurring E of the continental divide). Oviposition Eriogonum effusum pedicels, Westcliffe, Custer Co. Colo., July 1965. Oviposition 10:05 E. effusum calyx, Green Mtn., Jefferson Co. Colo., Aug. 18, 1977. Adults associated with E. effusum, 3 mi NW Castle Rock, Douglas Co. Colo., Aug. 2, 1977. Adults associated with E. effusum, 4 mi. NW Sedalia, Douglas Co. Colo., Aug. 2, 1977. Adults associated with E. effusum, Green Mtn., Jefferson Co. Colo., Sept. 12, 1987, Sept. 1, 1990.. Adults associated with E.

effusum, Nighswander, Douglas Co. Colo., July 30, 1984. Adults associated with E. effusum, Chimney Gulch, Jefferson Co. Colo., July 2, 1986. Adults associated with E. effusum, Red Rocks, Jefferson Co. Colo., Sept. 21-22, 1987. Adults associated with E. effusum, Barr Lake, Adams Co. Colo., Aug. 23, 1989. P. a. texanus must feed on a wide variety of Eriogonum, because adults are associated with Eriogonum corymbosum var. velutinum (R) at ridge 3 mi. S Cortez, Montezuma Co. Colo., Sept. 6, 1978, assoc. with Eriogonum annuum Nutt. (R) at Hwy. 285 11 rd. mi. N Espanola, Rio Arriba Co. New Mex., Sept. 9, 1977, assoc. with Eriogonum cernuum var. cernuum at Kerr Gulch, Fremont Co. Colo., Aug. 15, 1973, assoc. with E. c. var. cernuum (R) at Trout Creek 5.6 mi. SW jct. of hwy. 285 & 24, 8500', Chaffee Co. Colo., Aug. 29, 1977, and assoc. with Eriogonum wrightii var. wrightii (R) at 3 mi. W. Alma, Catron Co. New Mex., Aug. 9, 1986. Adults seem rather local and always occur near the Eriogonum hosts. It has been conjectured that acmon migrates northward each year on the plains, but this is doubtful: on the plains of S Colo. (Scott & Scott 1980) there are 7 records from May 4-June 8, 10 from June 26-July 31, 6 from Aug. 19-Sept. 14; on the plains near Denver acmon does seem most common L Aug.-E Sept., but flies in L Apr.-June also. Early stages from Bandimere Speedway: MATURE LARVA olive-green with red marks, T1 reddish-green, the rear slightly-reddish-green, a red middorsal band (wider anteriorly), on each segment is a narrow red longitudinal dash beside middorsal band, next a brown subdorsal slightly-oblique dash edged below by pale-olive-green and then another narrower brown dash, a white lateral band is edged above and below by a thick red band. PUPA wings translucent-pale-yellow, remainder slightly-reddish pale-creamy-yellow, with a weak pattern: orbit brown, a weak reddish flush around pronotum margin, a red flush at wing bases (except on front of T2), T3 notum with slightly-reddish margin, a faint red middorsal line on T2 and a weak red middorsal band on abdomen, four rows of weak reddish-tan dashes (the second row oblique) on abdomen, below them a red curved lateral band on abdomen (sharply-edged above with creamy-yellow).

Plebejus acmon lutzi (dos P.). Oviposition 14:26 two eggs inside corolla of Eriogonum subalpinum, she probed abdomen into E. subalpinum flowers many times; E. subalpinum was common at this site, only one Eriogonum umbellatum var. umbellatum plant seen; 1/2 mi. N Silverthorne, Summit Co. Colo., July 3, 1989. Adults associated with E. subalpinum, NW Tabernash, Grand Co. Colo., June 24, 1989. Adults associated with E. subalpinum, Moffat Tunnel, Gilpin Co. Colo., July 2, 1989. Adults associated with E. subalpinum (no umbels around stems of my specimen; previously misidentified as Eriogonum heracleoides var. heracleoides by J. Reveal, though possibly the specimen sent to him was heracleoides), Talamantes Creek, Moffat Co. Colo., July 8, 1972. 10 eggs (9 on hairy calyx, 1 on bract sheath around flower cluster) found on Eriogonum jamesi var. flavescens flower buds, and adults assoc. with it; Stove Mtn., ~9500', El Paso Co., Colo., June 23, 1990. 3 eggs found on bract, a 4-mm-long larva found eating flower buds, all on E. jamesi var. flavescens, Coal Creek, Jefferson Co. Colo., July 16, 1991. Adults associated with E. u. var. umbellatum, NW Nederland, Boulder Co., Colo., July 2, 1989. 4 eggs found on E. u. var. umbellatum (1 outside hairy bract, 1 inside bract, 2 on side of flower buds) (E. subalpinum also occurs here); SSW Hot Sulfur Springs, Grand Co. Colo., July 11, 1990. 2 eggs found on bracts below umbels of E. u. var. umbellatum; Golden Gate Can. State Park, Gilpin Co. Colo., July 25, 1990. Adults associated with E. u. var. umbellatum (no other Eriogonum present); Dory Hill, Gilpin Co. Colo., July 8, 1990. Oviposition 12:14 on side of E. u. var. umbellatum corolla while resting on top of flower; Apex Gulch, Jefferson Co. Colo., Aug. 27, 1990. Adults associated with Eriogonum pauciflorum var. pauciflorum (R), hill N I-90, 6.2 mi. SE Wall, Pennington Co. South Dakota, July 15, 1986.

Plebejus acmon spangellatus Burd. This little-known creature, characterized by much-smaller orange uph lunules and a darker-gray unh, is treated as a subspecies, because most altitudinal "forms" have proven to be genetically-distinct ssp. when reared under low-altitude conditions. It occurs above timberline in the Olympic Mts. Washington, the Alberta Rockies, and Colorado. 25 eggs seen on Eriogonum jamesi var. xanthum (= E. "flavum" var. xanthum) (most on bracts sheathing flowers, many on calyx); McClellan Mtn., 12800', Clear Creek Co., Colo., July 16, 1990. Egg found on E. j. var. xanthum bract sheathing flower; Mt. Bross, 13200', Park Co. Colo., July 17, 1990. ~20 eggs (17 bracts, 3 flowers) found on E. j. var. xanthum, McClellan Mtn., 12800-13000', Clear Creek Co., Colo., July 30, 1991. Adults are associated with E. j. var. xanthum at all of the following alpine zone locations in the Front Range, Sawatch Range, and Sangre de Cristo Mts.: McClellan Mtn. 12800', Clear Creek Co. Colo., July 15, 1980; Mt. Bross 13200', Park Co. Colo., July 31, 1982; Mt. Massive 12500', Lake Co. Colo., Aug. 1, 1982; Baldy Peak 12000', Custer Co. Colo., 29, July 1970; Dry Lakes 11500', Custer Co. Colo., July 16, 1968. It is also known from

Horseshoe Mtn. and Hall Valley, both alpine zone in Park Co. Adults fly about 10 cm above the host and are very local (because the plants grow only in local colonies) and uncommon. EGG whitish-green. 1ST-STAGE LARVA cream. 2ND-STAGE LARVA mostly cream with tan lines; one larva is cream with light-pink marks (middorsal line pink, 2 strong and 1 weak diagonal pink subdorsal dashes, a pink band above lateral cream ridge and a tan band below it. 3RD STAGE LARVA varies in color; some larvae yellow-cream, some yellow-green, some dull red; all have the same dark and pale lines and dashes (middorsal dark band edged by pale, 2 1/2 oblique pale dashes below it, a lateral pale ridge edged by dark); head black. LARVA 5-MM-LONG grayish-green, a subdorsal cream band, 3 faint creamy-green oblique dashes, a lateral cream band.

Plebejus lupini monticola (Clem.). Adults associated with Eriogonum umbellatum var. furcosum (R), Big Pine Meadow, Tulare Co. Calif., July 7, 1974.

Hemiarqus isola (Reak.). Oviposition 13:36 Trifolium repens flowers, Wetmore, Custer Co. Colo., Sept. 13, 1971. Ovipositions 9:40, 9:50 T. repens calyx, N of Idledale, Jefferson Co. Colo., Aug. 21, 1977. Oviposition 9:46 on convex (dorsal) side of Poa pratensis 1.5-mm-wide leaf extending into T. repens flower cluster (she landed on flower and bent abdomen down and abdomen contacted the grass by mistake), Lakewood, Jefferson Co. Colo., Aug. 8, 1989. Egg found T. repens flower, Plum Creek, Sedalia, Douglas Co. Colo., Sept. 18, 1990. Oviposition 10:02 on flowers of Trifolium rusbyi (= longipes [W], the name given in Scott 1986a), E Hopewell Lake Cgd., 9800', Rio Arriba Co. New Mex., June 21, 1978. Oviposition 10:28 on flower in head of Trifolium fragiferum, Lakewood, Jefferson Co. Colo., July 14, 1984. Two bluish-green eggs found on calyx, 1 larva found boring into papery calyx, about 15 other larvae later emerged from papery seed heads that were picked and placed into boxes (larvae bore into the green seeds inside the brown papery calyx so often disappear into the calyx), all on T. fragiferum, 3 larvae reared to adults, Barr Lake, Adams Co. Colo., Sept. 28, 1987. Adults common associated with T. fragiferum, Barr Lake, Adams Co. Colo., Aug. 30 and Sept. 2, 1987, Aug. 23, 1989. Oviposition 14:25 T. fragiferum sepal sheath 1/3 of way inside flower head, Barr Lake, Adams Co. Colo., Aug. 27, 1988. Egg found T. fragiferum corolla, and preoviposition 12:25 T. fragiferum; Wheatridge, Jefferson Co. Colo., Aug. 16, 1990. Oviposition 11:40 among Trifolium pratense flower buds, Wheatridge, Jefferson Co. Colo., June 29, 1989. Oviposition 12:45 T. pratense bract underside (another female ignored T. pratense and only landed on Astragalus flexuosus), Tinytown, Jefferson Co. Colo., July 1, 1991. Oviposition 10:34 between flower buds of Medicago sativa, 14 mi. N Camp Cottonwood, Montezuma Can., San Juan Co. Utah, Aug. 25, 1977. Oviposition 15:00 inside young 5-mm-long M. sativa flower, Barr Lake, Adams Co. Colo., Sept. 5, 1989. Oviposition 12:50 on flower buds of Dalea purpurea (W), Chimney Gulch, Jefferson Co. Colo., July 10, 1978. Adults associated with Dalea scoparia (W), sand dunes 5 mi. N San Felipe Pueblo, Sandoval Co. New Mex., Sept. 9, 1977. 21 eggs found among flowers Dalea candida var. oligophylla; 20 eggs found on Dalea jamesii mostly stuck to the long white hairy sepal lobes; ~10 Astragalus missouriensis pods burrowed out by lycaenid undoubtedly H. isola and frass found in one hole; no eggs found on Psoralea tenuiflora; N Pueblo, Pueblo Co. Colo. June 8, 1991. 1 egg found on Astragalus missouriensis sepal; no eggs found on many Oxytropis multiceps (has long silky calyx); W Deckers, Jefferson Co. Colo., June 10, 1991. Two eggs (identical to eggs dissected from female) found on flower buds of Glycyrrhiza lepidota, Briggsdale, Weld Co. Colo., June 14, 1977. Ovipositions 12:07, 12:09, 12:10, 12:12, 12:15 on young flower heads of G. lepidota, Green Mtn., Jefferson Co. Colo., June 30, 1978. Oviposition 9:40 on young flower buds of G. lepidota, Chimney Gulch, Jefferson Co. Colo., July 1, 1978. Oviposition 10:04 on flower buds of Melilotus alba, Golden Gate Can., Jefferson Co. Colo., July 8, 1978. Oviposition on Rhynchosia texana, Pena Blanca Lake, Santa Cruz Co. Ariz., Aug. 5, 1986. Egg found on Oxytropis lamberti flower bud sepal, Lowry Bombing Range, Arapahoe Co. Colo., May 25, 1991. 1 egg found on O. lamberti sepal, Box Elder Creek, Elbert Co. Colo., May 26, 1991. Oviposition 10:59 Medicago lupulina flower buds, Roxborough Park, Jefferson Co. Colo., Aug. 14, 1991. Oviposition 11:20 on half-grown M. lupulina fruit, 6 eggs found on Astragalus bisulcatus flower buds, 10 eggs found on Astragalus agrestis flower buds, 6 eggs found on Astragalus drummondii flower buds, 1 egg found on Melilotus officinalis flower bud (few eggs were found on this indicating it is not a popular host), no eggs found on Oxytropis sericea flower buds (but most buds too old); Green Mtn., Jefferson Co. Colo., May 27, 1991. Oviposition 13:10 on very young flower buds, oviposition 13:12 flower buds, and 1 egg found on sepal, all on Oxytropis lamberti; 8 eggs found on Astragalus flexuosus flower buds; 9 eggs found on Astragalus parryi flower buds; no eggs found on Lupinus argenteus (obviously shunned by females); Apex County Park, Jefferson Co. Colo., May 29, 1991. 6

eggs found on sepals Astragalus adsurgens var. robustior, S. Table Mtn., Jefferson Co. Colo., May 30, 1991. 4-mm-long larva probably H. isola found on A. a. var. robustior flower, Tapinoma sessile ant workers found on larvae; N fork Clear Creek, Gilpin Co. Colo., July 11, 1991. 6 eggs found on Astragalus agrestis sepals, 1 egg found on Astragalus flexuosus sepal, Green Mtn., Jefferson Co. Colo., June 3, 1991. Ovipositions 12:30, 12:40, 12:45 on Oxytropis lamberti flower buds, 2 eggs found on Astragalus flexuosus flower buds, Mt. Vernon Historic Site, Jefferson Co. Colo., June 4, 1991. Oviposition 10:45 and 12 eggs found on Astragalus parryi sepals, 11 eggs found on Astragalus flexuosus sepals, no eggs found on Thermopsis divaricarpa, Tinytown, Jefferson Co. Colo., June 5, 1991. Oviposition 10:26 Medicago lupulina flower buds, 3 eggs found on Melilotus officinalis flower buds, 11 eggs found on Astragalus agrestis flower buds, 4 eggs found on Oxytropis lamberti flower buds, 6 eggs found on Astragalus flexuosus flower buds, 12 eggs found on Astragalus drummondii flower buds, 0 eggs found on one Astragalus adsurgens plant, 0 eggs found on one Astragalus shortianus plant, 0 eggs found on Lupinus argenteus, 0 eggs found on Thermopsis divaricarpa, 0 eggs found on Psoralea tenuiflora; Lookout Mtn., Jefferson Co. Colo., June 6, 1991. 1 egg found on Oxytropis lamberti flower bud sepal; 4 eggs found on Astragalus sparsiflorus var. maiusculus flower buds; no eggs found on Oxytropis multiceps; W Deckers, Jefferson Co. Colo., June 11, 1991. 2 eggs found on Astragalus (gracilis) parviflorus flower buds; 1 egg 2 eggshells found (2 on flower buds, 1 under leaf) on Amorpha canescens; S Gothenburg, Dawson Co. Neb., June 15, 1991. 2 eggs found (1 on sepal tip, 1 on base of flower pedicel) on Coronilla varia, Lakewood, Jefferson Co. Colo., June 9, 1991. HOSTPLANTS: 25 legumes are known so far, and evidently most legumes are suitable; in decreasing order of number of records they are Astragalus flexuosus, Astragalus agrestis, Astragalus parryi, Trifolium fragiferum, Dalea candida var. oligophylla, Dalea jamesii, Astragalus drummondii, Oxytropis lamberti, Astragalus missouriensis, Glycyrrhiza lepidota, Astragalus adsurgens var. robustior, Astragalus bisulcatus, Trifolium repens, Melilotus officinalis, Astragalus sparsiflorus var. maiusculus, Medicago lupulina, Amorpha canescens, Trifolium pratense, Medicago sativa, Coronilla varia, Astragalus (gracilis) parviflorus, Dalea purpurea, Trifolium rusbyi, Melilotus alba, Rhynchosia texana. Oxytropis and Glycyrrhiza I would have thought would not be popular but they both have a number of records; Melilotus is not preferred, and Medicago lupulina and Trifolium pratense are probably not preferred either. Some legumes seem to be shunned: Lupinus argenteus, Oxytropis multiceps, Thermopsis divaricarpa, Psoralea tenuiflora. When adults are scarce (in most years) they usually occur in moist habitats and choose hosts normally found there rather than dryland legumes such as Astragalus, though in 1991 adults were widespread including in dry areas. Larvae must greatly prefer flower buds/flowers/fruits. EARLY STAGES from Barr Lake: No diapause in lab. EGG light bluish-green or greenish-white. FIRST-STAGE LARVA yellowish-cream-tan; head dark brown. MATURE LARVA overall appearance usually whitish-green with red marks and ground color whitish-green (some larvae pale-green with red & green marks and ground color pale-green; others green with red & green marks and ground color yellow-green), T1 with a long transverse dorsal reddish stripe, T2 with a large red middorsal circle, a wide middorsal white-edged band of joined maroon circular spots on T3-A6 tapers posteriorly to a middorsal band on A7-10 (on larvae with pale-green and yellow-green ground color, the rear of each middorsal red spot is green and the spots are connected by green constrictions), a short red-brown dash on front of segment below middorsal band (absent in greener larvae), then a long oblique (pointed posteroventrally) red-brown dash (green in pale-green ground color larvae, dark-green in yellow-green ground color larvae), then a narrower oblique (less oblique but still angled posteroventrally) red-brown dash (light-green in pale-green ground color larvae, green in yellow-green ground color larvae), a lateral row of short red dashes (each curved dorsoposteriorly) above a row of long red dashes, a white row of dashes between these two lateral rows; head very small, brown. Mature larvae are not as variable as many other Lycaenidae, so the color pattern is useful for identification. PUPA light-yellowish-green with a tan tinge, underside pale-green, abdomen light-yellow on top and side with a middorsal light-green line and 6-7 oblique light-reddish-brown bands extending posterolaterally to a lateral light-reddish-brown band, below this on abdomen a shorter lateral reddish-brown band edged below by cream then a reddish-brown lateral line, pupa attached by silk girdle and cremaster; another pupa the same but abdominal pattern very faint, a third pupa light-green with a tan tint, abdominal pattern very faint with slightly darker light-green marks. Prior to adult emergence, the eyes and proboscis tip turn blackish before the entire pupa does. Pupal stage 10 days in lab.

Piruna pirus. Ovipositions 13:15, 13:16, 13:22 on underside of Agropyron (Elyttria) repens leaves, oviposition 14:38 on underside of A. (E.) repens leaf and another egg found on underside of a leaf of same plant, oviposition 14:07 on underside of Agrostis gigantea leaf, Wheatridge, Jefferson Co. Colo., July 7, 1988. 12 eggs (2 empty) found on underside of Dactylis glomerata leaves, 5 eggs found on underside of Bromus (Bromopsis) inermis leaves, 4 eggs found on underside of Agropyron (Elyttria) repens leaves, 4 eggs found on underside of Agrostis gigantea leaves, 1 egg found on underside of Agropyron (Elymus) canadensis leaf, Wheatridge, Jefferson Co. Colo., July 8, 1988. 8 eggs (1 eggshell was empty but a 1st-stage larva was found on topmost leaf folded upward and tied with 7 silk cables) found on underside of Agropyron (Elyttria) repens leaves, Wheatridge, Jefferson Co. Colo., July 11, 1988. Oviposition 9:19 on underside of Agropyron (Elyttria) repens leaf and another egg found on underside of same leaf, oviposition 9:47 on underside of A. (E.) repens leaf, 5 eggs found on underside of A. (E.) repens leaves, 4 eggs found on underside of Agrostis gigantea leaves, 3 eggs found on underside of Dactylis glomerata leaves of one large clump, Wheatridge, Jefferson Co. Colo., July 13, 1988. 5 larvae in nests on Agropyron (Elyttria) repens, 5 larvae in nests on Bromus (Bromopsis) inermis, Wheatridge, Jefferson Co. Colo., Aug. 12, 1988. 1 larva found in Bromus (Bromopsis) inermis leaf nest, 1 larva found in Phalaris (Phalaroides) arundinacea leaf nest, ~15 larvae (all ~1 cm long) found in Agropyron (Elyttria) repens leaf nests, 1 pupal shell (shell identified as pirus rather than Oarisma garita because distance from tip of leg to wingtip 2.7 mm, proboscis extends only to wingtip, pupa leaf nest resembled pirus, and P. pirus is common but O. garita has never been found at the shaded site where the pupal shell was found, though garita occurs 40 m away in a Bromus [Bromopsis] inermis meadow) found in A. (E.) repens leaf (the leaf constricted partially by feeding, then 1 cm distal to the constriction was a 35 x 5 mm silk mat on the leaf top on which the pupa was attached, head toward the leaf base, the pupa attached by the cremaster and a silk girdle circling the pupa over T3 just behind T2), Wheatridge, Jefferson Co. Colo., Aug. 22, 1988. 1 empty larval nest found on Dactylis glomerata, 1 empty larval nest found on Bromus (Bromopsis) inermis, 1 larva found in Agrostis gigantea leaf nest, 1 larva and 5 empty larval nests (3 with molted head capsules) found on Agropyron (Elyttria) repens, Wheatridge, Jefferson Co. Colo., Aug. 29, 1988. 1 larva 1 cm long found in leaf nest, 1 empty leaf nest found, both on Agropyron (Elymus) canadensis, Falcon County Park, Jefferson Co. Colo., Aug. 30, 1988. 1 larva found in Dactylis glomerata leaf nest, Chimney Gulch, Jefferson Co. Colo., Aug. 30, 1988. 1 larva in rolled leaf nest and ~15 empty nests on Agropyron (Elyttria) repens, 2 larvae in rolled-leaf nests and ~10 empty nests on Bromus (Bromopsis) inermis, 2 empty rolled-leaf nests on Agrostis gigantea, all 3 larvae were 9-10 mm long with 1 mm wide black heads with a touch of orangish-brown (~3rd stage) and were diapausing (not feeding), Wheatridge, Jefferson Co. Colo., Oct. 1, 1988. One ~9 mm long 3rd-stage diapausing (non-feeding) larva found in rolled leaf nest on Bromus (Bromopsis) inermis, ~15 empty larval nests found in B. inermis, 1 empty larval nest (typical nest, the leaf base untouched for 55 mm, then the leaf bared to the midrib for 20 mm, the next 80 mm of the 3.5-mm-wide young leaf rolled upward into a tube with the usual silk threads inside the tube, the remainder of leaf eaten beyond tube) found in Calamagrostis canadensis, Wheatridge, Jefferson Co. Colo., Oct. 3, 1988. 1 empty larval nest found on Phalaris (Phalaroides) arundinacea (typical nest, the leaf constricted to midrib basal to tube, tube covered with silk inside and also leaf edges connected by 5-7 multi-strand silk cords on basal half of tube), Wheatridge, Jefferson Co. Colo., Oct. 4, 1988. 1 empty larval nest (typical, leaf chewed to midrib for 22 mm basal to tube) found near top of Agropyron (Elyttria) intermedium plant, Mt. Vernon Historic Site, Jefferson Co. Colo., Oct. 7, 1988. A very dense very local colony occurred in Wheatridge in 1988 & 1989, enabling observations to be easily made; the colony numbered a hundred or more adults daily, and was concentrated in an area only about 40 x 10 m (with scattered individuals widespread elsewhere), centered on a large flowering Cirsium arvense patch next to trees beside a cattail slough. 1 empty larval nest on Agropyron (Elyttria) repens, Cherry Creek, Denver, Denver Co., Colo., Oct. 20, 1988. 10 larvae and 4 empty larval nests found on Agropyron (Elyttria) repens, 2 larvae and 2 empty nests found on Agrostis gigantea, 1 larva found on Bromus (Bromopsis) inermis, 2 larvae found on Agropyron (Elymus) canadensis; 7 larvae had head facing leaf base, 5 facing away from leaf base, all larvae half-grown and in standard drooping nests except 1 larva in a nest of 2 leaves silked together and drooping (both leaves chewed to

midrib basal to nest) and 1 larva in nest of 2 leaves silked together; Wheatridge, Jefferson Co. Colo., June 5, 1989. Oviposition 11:19 on Agropyron (Elytrigia) repens (repens 0-100) leaf underside in understory of Melilotus alba & Cirsium arvense and in shade of Salix amygdaloides tree; 14 eggs found on Bromus (Bromopsis) inermis leaf undersides, and 1 egg found on Dactylis glomerata leaf underside, most of these 15 eggs in shade of Eleagnus angustifolia trees; Wheatridge, Jefferson Co. Colo., July 11, 1989. 2 eggs found on Phleum pratense leaf underside, 1 egg found on Bromus (Bromopsis) lanatipes leaf underside, Tucker Gulch, Jefferson Co. Colo., July 13, 1989. 1 egg found on Muhlenbergia racemosa leaf underside (M. racemosa common nearby, Phleum pratense, Poa, Agropyron (Elymus) canadensis, Agrostis gigantea within 1 m also), Apex Gulch, Jefferson Co. Colo., July 15, 1989. 1 egg found on Dactylis glomerata, 1 egg found on Bromus (Bromopsis) inermis, 1 egg found on Agropyron (Elytrigia) intermedium, Chimney Gulch, Jefferson Co. Colo., July 16, 1989. 1 egg found on Glyceria striata leaf top, Apex Gulch, Jefferson Co. Colo., July 17, 1989. 1 empty larval nest found on Agrostis gigantea, S Cooley Gravel Quarry, Jefferson Co. Colo., Aug. 10, 1989. 1 larval nest (probably Piruna) found on Agropyron (Elymus) trachycaulum (nest of 2 leaves, the lower leaf bared to midrib below larva, the upper leaf bared to midrib above larva), Mt. Falcon, Jefferson Co. Colo., Aug. 26, 1989. 6 larvae (one 4th-stage larva was 8-mm-long with dark patterned head 1.0 mm wide, five 5th-stage larvae were 10-mm-long with white-and-reddish-brown-striped head 1.2-1.3 mm wide) found in typical leaf nests on one! Bromus (Bromopsis) lanatipes clump, the only B. lanatipes plant seen (many nearby Agropyron (Elymus) trachycaulum plants had no larvae), perhaps a dying female landed on this clump and laid all her eggs there, N-facing slope on Beaver Brook Trail, Jefferson Co. Colo., Aug. 28, 1989. A 10-mm-long 4th-5th-stage larva with head 1.2 mm wide found in a new Agropyron (Elymus) ambiguus leaf nest of 2 leaves (the head toward leaf base), and a nearby leaf had old abandoned nest with leaf chewed down to midrib; small eggshell base (size of Piruna) found on Muhlenbergia racemosa leaf underside; Lookout Mtn., Jefferson Co. Colo., Sept. 2, 1989. 2 blackish eggs with Trichogrammatid exit hole found on underside of 3-mm-wide dead lower leaves of same Bromus (Bromopsis) lanatipes plant, N-facing non-wooded slope among cliff rocks, Red Rocks, Jefferson Co. Colo., Sept. 4, 1989. 5th stage larva 10-mm-long with striped head 1.3 mm wide found in silked-leaf nest on Agropyron (Elymus) trachycaulum, Lookout Mtn., Jefferson Co. Colo., Sept 4, 1989. 2 recently-dead 4th-stage 12-mm-long larvae with heads 1.1 mm wide found in Bromus (Bromopsis) inermis leaf nests (one had head facing leaf base, one facing away), 1 empty larval nest found on Dactylis glomerata, ~5 empty larval nests found on Agropyron (Elytrigia) repens, N-facing slope and creek at Wheatridge, Jefferson Co. Colo., Sept. 18, 1989. Oviposition 8:56 on horizontal Dactylis glomerata leaf underside (4 cm above ground on leaf 2.5 mm wide, 4.5 cm from tip); oviposition 9:25 on Agropyron (Elytrigia) repens (25 cm above ground on leaf 3 mm wide, 11 cm from leaf tip); egg found on Agropyron cristatum desertorum leaf (27 cm above ground on leaf 2-3 mm wide, 10.5 cm from leaf tip); all three eggs in complete or partial shade near creek; Lakewood, Jefferson Co. Colo., June 27, 1990. 18-mm-long larva found on Agropyron (Elymus) trachycaulum (larva resting 14 cm from tip just beyond chewed constriction and facing leaf base, resting on top of leaf because leaf was only 3.5 mm wide, too narrow to be rolled into a tube), on sunny W-facing gulch bank; empty larval nest found on Bromus (Bromopsis) lanatipes; Tinytown, Jefferson Co. Colo., June 28, 1990. Egg found on Agropyron (Elytrigia) repens leaf underside (50 cm above ground on 3-mm-wide leaf, 4 cm from leaf tip); egg found Agropyron (Elymus) trachycaulum (40 cm, 5 mm, near tip on leaf pointing upward); egg found on Agropyron (Elymus) ambiguus (45, 4.5, 15); egg found A. (L.) ambiguus (30, 5.5, 25); egg found A. (L.) ambiguus (35, 7, 25); egg A. (L.) ambiguus (30, 5, 19); egg Bromus (Bromopsis) lanatipes (30, 3, 8); some Phleum pratense and some Agropyron (Elymus) canadensis were also searched; some eggs in gulch, some on N-facing slope; Red Rocks, Jefferson Co. Colo., June 30, 1990. Egg found on Agrostis gigantea leaf underside (24 cm above ground on 4-mm-wide leaf, ~6 cm from leaf tip) in shaded gulch; egg found Agropyron (Elymus) ambiguus leaf underside (30 cm, 3 mm, 13 cm) on very sunny N-facing slope; Tucker Gulch, Jefferson Co. Colo., July 1, 1990. Egg found on Bromus (Bromopsis) lanatipes leaf underside (50 cm above ground on 6-mm-wide leaf, 7 cm from leaf tip), in gulch in partial shade; Tinytown, Jefferson Co. Colo., July 2, 1990. Oviposition 12:15 on Agropyron (Elymus) canadensis leaf underside, 2 eggshells found 7 & 10 mm away beneath same leaf, 1 1st-stage larva in silked tube cinched by 6 multistrand silk ropes on same leaf (20 cm above ground on 4-mm-wide leaf, ~9 cm from leaf tip), in shade of bush on SE-facing gulch bank; Falcon County Park, Jefferson Co. Colo., July 10, 1990. Female bent abdomen on Festuca arundinacea, then oviposited 11:09 on young

Agropyron (Elytrigia) repens sprout (10 cm above ground on 3-mm-wide leaf underside, 3.5 cm from leaf tip), then same female oviposited 11:11 on older A. (E.) repens plant on leaf underside (30 cm above ground on 3-mm-wide leaf, 10 cm from leaf tip), all under S canopy of tree but partial shade was mostly due to intermixed taller plants; 4 eggs found on Leersia oryzoides (leaves 5 mm wide 8 cm from leaf tip on upperside of leaf, 6-10-underside, 4-7-ups, 8-8-ups) (these leaves are very thin and have recurved hooks so grasp nearby plants and often turn upside down), in tree shade next to water; Wheatridge, Jefferson Co. Colo., July 14, 1990. 2 larvae 1 cm long found on Bromus (Bromopsis) inermis in shade of tree; Wheatridge, Jefferson Co. Colo., Aug. 23, 1990. Larva found 8 mm long on Agropyron (Elymus) canadensis in typical dangling nest; larva 11 mm long found Dactylis glomerata; partly shaded gulches; Tinytown, Jefferson Co. Colo., Aug. 29, 1990. Larva 14 mm long found head downward in Agropyron (Elymus) trachycaulum nest of 3 leaves ~8 cm above ground; N Oak Creek Cgd., Fremont Co. Colo., Sept. 11, 1990. **HOSTPLANTS:** All 16 grasses are hostplants: Agropyron (Elytrigia) repens (93 eggs or larvae or nests found) and Bromus (Bromopsis) inermis (58) are no doubt the commonest hosts because the plants are so common (but they are eaten less often than these numbers suggest in the most natural habitats), Dactylis glomerata (22) and Agrostis gigantea (18) are less common so are less-often used (but D. glomerata is favored where it occurs), Bromus (Bromopsis) lanatipes (12) and Agropyron (Elymus) ambiguus (6) grow mostly on N-facing slopes (though females do sometimes oviposit on N-facing slopes) so are eaten less often than common gulch grasses, Agropyron (Elymus) canadensis (9) is spotty in occurrence so is less often used, Agropyron (Elymus) trachycaulum (5) is less often used because the plants grow mostly on slopes, (the last 6 grasses are the usual hosts in the most natural habitats), Phleum pratense (2) is also spotty in occurrence but may be used more often than the 2 records indicate, Muhlenbergia racemosa (2) and Glyceria striata (1) are uncommon gulch bottom/creekside plants so are uncommon hosts, Leersia oryzoides (4), Agropyron (Elytrigia) intermedium (2), Phalaris (Phalaroides) arundinacea (2, a very large grass, height up to 2 m, leaves up to 2 cm wide), Calamagrostis canadensis (1) all occur at very few sites so are seldom hostplants, and Agropyron cristatum desertorum is mostly planted on road banks for soil stabilization so is seldom in the right habitat. The hosts are "hay" grasses, all have wide (3-15 mm) leaves, all are tall (30-150 cm), most have rhizomes and grow in individual stalks rather than tight clumps (few exceptions: A. trachycaulum, A. cristatum, and B. lanatipes grow in clumps, D. glomerata grows in a sprawling clump up to 30 cm or more wide, each blade much longer than the leaves of other hosts, A. [L.] ambiguus grows in giant clumps or patches up to 150 cm wide and often has rhizomes), and all have somewhat stiff leaves (except D. glomerata, G. striata, & L. oryzoides leaves are more floppy and rather succulent, though the latter's leaves are tougher and have sawtooth edges). D. glomerata seems to be the most preferred hostplant because few plants had many eggs, and its leaves are the most succulent of all the grasses, but it has more leaves per plant so the comparison is unequal; the other hosts may have no differences in preference, and the number of records on these hosts mostly depends on their abundance. In the lab, larvae ate Poa pratensis, B. inermis and D. glomerata, but survival was low in the lab and larval growth rates were very slow compared to Hesperinae larvae (P. pirus has only one generation per year, despite the small food requirements of its small adults). Phragmites australis (= communis), a very tall single-stem grass, occurs at Wheatridge and may eventually be found to be a hostplant but was too uncommon and too far from the concentration of adults to have eggs or larvae. Many clumps of Festuca arundinacea were searched but no eggs or larvae were found, even when adjacent A. (Elytrigia) repens had larvae, so F. arundinacea is apparently not used despite its wide leaves (it closely resembles D. glomerata in its large clumps and sprawling very long wide leaves, but its leaves are much tougher, like straps). Most of the hostplants are widespread in range, and several are introduced from Eurasia. However, Piruna pirus has a much smaller range than these grasses, and is often very local where it occurs, so hostplants are not limiting factors. Most ovipositions, eggs, and larvae occur in shaded or semi-shaded areas, such as the shade under trees (Salix amygdaloides, Eleagnus angustifolia, Salix exigua, Ulmus sibirica, Acer negundo, Populus sargentii) or bushes (Cornus stolonifera) or the shade within a dense Cirsium arvense patch where the 1.5 m C. arvense plants shade the 0.5-1 m grasses; the preference for shade prevents their occurrence in most hayfields and pastures, and explains why P. pirus almost always occurs along creeks or gulch bottoms or near trees (some immatures were found on N-facing slopes also, so females occur there sometimes). Most eggs are laid on younger more tender individuals of the preferred grass species, though some eggs are laid on old tough leaves. Poaes zabulon taxiles and Ochloides sylvanoides also choose wide-

leaf fall "hay" grasses mostly in shade; I think the reason for P. z. taxiles and pirus's preference for shade is that half-grown larvae hibernate, and the grasses in shade stay greener longer in the year so that in a dry year only the grasses in shade would stay green long enough for the larvae to become big enough to diapause. By late Aug. in the sunnier areas the grass plants that fruited that summer are starting to dry, and by Oct. 1 they are mostly dried out and only the young grass shoots near the ground are still green, whereas in the shade next to water or in shade under trees some grasses stay green even until mid Oct. So larvae in sunnier areas would often have to transfer and crawl around to find a young green shoot, which would increase mortality and cause more energy expenditure to make a new silk nest. However, larvae do withstand drying of their host fairly well, as long as it becomes green later: ~5 larvae from Wheatridge, Jefferson Co. Colo., ~Oct. 5, 1988, were overwintered in a refrigerator, and one lived until March 1989 when it was placed on a potted Dactylis glomerata plant, which it ate for a week, then the leaves around it dried and turned brown, yet the larva remained alive in the same dried nest for TWO MONTHS (I thought it was dead), when it was given fresh leaves and emerged as an adult July 1989. Perhaps shade preference is a genetic holdover from the ancestors of Piruna, a tropical group reaching the U.S. from hotter Mexico.

LARVAL NEST: The larva chooses a leaf generally at or near the top of the plant, curls the leaf upward with silk and fastens the leaf edges together with a mat of silk all over the inside of the tube and the edges secured with ~7-8 multi-strand cords of silk. The larva lives in the tube, usually with head facing the leaf base and the tube closed behind the larva, and eats the sides of a 20-30 mm length of the leaf basal to the nest except for the midrib, and eats the leaf tip distal to the tube. Thus the typical nest has much of the leaf base intact and angled upward 30-40°, then the bare midrib extends outward and curves downward for 20-30 mm, then the hanging leaf nest is rolled into a tube with the larva resting inside, head usually upward (toward leaf base), and the leaf tip is missing (eaten). Most larvae (and pupae) rest with head facing upward (toward leaf base) but about 30% had head pointing downward (away). Leaves that are propped upward by touching other plants may have other modifications of this nest, for instance two nests had the tube formed of a leaf and an adjacent leaf, and one leaf that had two larvae had two separate chewed constrictions of the leaf, and in the lab a larva sometimes made a nest in which nylon netting formed one side of the nest (proving that tactile stimulus from the tube rather than darkness is sought by a nest-building larva), but the larva always lives in a leaf tube and always eats the leaf near the nest down to the midrib. This chewed-to-midrib type of leaf nest is unique within Hesperidae in my experience, and enables larvae to be found even more readily than eggs. The nest is similar to those of Vanessa atalanta and Polygonia satyrus, which cut the Urtica leaf petiole slightly to make the leaf droop and then live in the rolled leaf; however there are differences (both have to chew the petiole very little to make the leaf droop, V. atalanta and probably P. satyrus eats the end of the leaf distal to the larva, and P. satyrus rolls the leaf downward instead of upward). **HIBERNATION STAGE:** Larvae have 6 stages, and 4th- and 5th-stage larvae about 1 cm long hibernate most often, 3rd-stage larvae hibernate sometimes, judging by the size of larvae found in nature at the end of Aug.-Oct 3 (nearly all larvae reach diapause size by Aug. 22) and June 5, and the high mortality of these larvae in the lab due to cessation of feeding. They seem to hibernate in the larval nest, because 4 diapausing larvae were still in their chewed-to-midrib larval nests Oct. 1-3 (when placed on leaves in the lab, these 4 rolled the leaf into a tube cinched by ~7 silk cords, and did not feed), but many nests in nature were empty by late Aug., perhaps due to predation. The strong larval diapause of Heteropterinae contrasts with Hesperinae; most Hesperinae that I have reared have not diapaused as larvae in the lab (except for Stinga and Amblyscirtes) even when it is known that they hibernate as larvae in nature. **DESCRIPTION OF EARLY STAGES:** EGG slightly-greenish cream, 2 depression on top, hemispherical, with faint vertical ribs on lower third of egg. Egg smaller than Poanes zabulon taxiles, greenish-cream versus cream, hemispherical versus more tapered on sides, with faint vertical ribs on lower third of egg versus unribbed. **FIRST-STAGE LARVA** cream with darker-cream heart line, turning greenish after feeding with green heart-line, the stripes of later stages hardly noticeable; collar and head black, head width 0.4-0.5 mm. **2ND-STAGE LARVA** light green, with weak stripes like later stages, collar black; head black, head width 0.6 mm. **3RD-STAGE LARVA** light green, with a wide cream band beside middorsal green line, a subdorsal narrow cream line edged by green (T1 has only the subdorsal cream line which turns medially to join its fellow on other side of body just behind head), collar black; head dark red-brown, an ochre ventral area near eyes, an ochre vertical streak (faint dorsally) extending upward in front

of eyes, a narrow weak ochre streak beside lower half of coronal sulcus and upper half of adfrontal sulcus, head width 0.7-0.8 mm. 4TH-STAGE LARVA green to greenish-white, a wide pale-green band next to middorsal green band, a subdorsal narrow pale-green line, some larvae have a very weak supralateral pale green line on abdomen, A10 greenish, collar black; head dark brown, a cream vertical band extending upward from just in front of eyes, a shorter cream spikelike vertical band extending upward just behind eyes, head width 1.0-1.1 mm. 4th-stage larvae vary greatly on the body, which always has two paler fairly wide stripes beside a middorsal line, and always has a narrower paler subdorsal stripe: larvae vary from mostly greenish-white with green lines (1 middorsal, 2 subdorsal on each side), to mostly green with paler green bands (a wide band beside middorsal line, a narrow subdorsal line). 4th-stage larvae vary greatly on the head, which varies from mostly reddish-brown to mostly cream: the darkest heads are entirely blackish-brown with one cream stripe extending dorsally from just in front of the eyes and two very faint cream-brown stripes paralleling the cream stripe, the palest heads have the frontoclypeus tan, edged above with black, adfrontal areas and beside coronal sulcus reddish-brown, tan beside that, then a narrow reddish-brown line beside adfrontal areas, a broad white vertical band, then a reddish-brown broad band extending dorsally from eyes (narrowing at the top and curving toward middorsal notch), this band edged laterally except at top by white, side of head tan, the narrow rim beside neck black. 5TH-STAGE LARVA green with pattern like 6th-stage larva, and some of the variation in head of 4th stage still present; head width 1.3 mm. MATURE (6TH-STAGE) LARVA green, covered with thousands of tiny cream hairs, a dark-green heart-line, a pale-green band beside it, then a subdorsal white line edged by dark-green, then a pale-green narrow band (all these lines & bands extend 2/3 onto A10 also) the side and ventrum green, side of proleg pale-green, a silvery lateral trachea faintly visible; head light olive-green, an orange-brown stripe extends upward from eyes 1-4 then narrows and terminates as it reaches top of head, this stripe edged posteriorly by a cream band similarly narrowed at top and edged anteriorly by a cream band which is still wide at the top and is very narrow just in front of eyes (all 3 bands end at the same spot near top of head), coronal sulcus & adfrontal cleavage line pale-green, labrum & around mandibles white, eyes black (eye #3 large, #4 smaller, #5 still smaller, #1, 2, 6 tiny), head width 2.0 mm. P. pirus larvae are easily distinguished from Poanes zabulon taxiles larvae by the head (in pirus rectangular, black when small in stages 1-3 or striped when larger in stages 4-6; in taxiles round and reddish-brown), and the leaf nests differ. PUPA slightly translucent, green on thorax & head & front of wings, yellowish-green on rear of wings & abdomen, a greenish-cream band on T2-A8 just beside middorsal green band, then a narrow subdorsal yellowish-cream line on T2-A8 (weak A9-10), a very slightly-pinkish translucent-cream anterior-projecting slightly-upturned head horn 0.8-1 mm long, a cream spot just beyond proboscis tip, cremaster translucent cream, ~1.5 mm long, T1 spiracle not elevated above surface of pupa, wingtip unnotched, antenna-wingtip distance 3.6-3.7 mm, leg-wingtip distance 2.6-2.8 mm, proboscis extends only to wingtip, pupa length 15-16 mm, pupa attached by cremaster and by silk girdle between T2 & T3 extending down over rear of T3 at its anteriormost point then attached to silk of leaf nest, most pupae have head upward in nest. Pupal stage lasts 13 days for males. ~11 days after pupation the wings become yellow-white, the adult eye becomes visibly orange and is centered under pupal orbit (orange adult eye lies under anterior half of pupal eye and under pupal orbit and slightly beyond pupal orbit) (in other words, pupal eye does not correspond exactly with adult eye), then T2 becomes darker and turns yellow, the eye becomes bright orange-red, abdomen tip becomes tan; at ~12 days the eyes, thorax, & wings become blackish (the antenna club ochre), the abdomen greenish-yellow, abdomen tip light brown, legs red-brown; then the entire pupa becomes dark the day before emergence. An internal longitudinal lateral trachea just beneath surface forms a narrow white line on A2-9 (weak on A8-9), and on A5-6-7 a transverse ventral trachea is visible that bulges posteriorly midventrally. Tracheae are visible on wings of young pupa: Sc and R1 are covered distally by antenna, R4-5 splits from R1 basad of R2-3, M1-2-3 are wholly visible and M3 branches near base of M whereas M2-3 fork near end of discal cell, CuP branches from base of Cu just basad of CuA, only one A vein visible ("1A & 2A"), beneath these tracheae on 1-2 day old pupa are visible apparent veins, and on wing base at base of Sc & R is a flap that beats once per second (evidently a valve to pump blood into wing). ADULT BEHAVIOR. Adults never bask with forewings spread less than hindwings (the basking posture of Hesperiniinae-Megathyminae, and a shared derived trait of their evolutionary branch). I saw more than 100 basking adults, and they always spread all four wings equally wide, from 15° to (most often) about 70° from vertical; in hot weather they raise the wings vertically. 4 females were

observed to close the wings to avoid detection when males flew overhead. When feeding they usually spread all wings 60-70° also, but sometimes close them. They may close the wings when resting especially in cold weather, and they roost with wings closed. Adults feed often on flowers of Cirsium arvense and Medicago sativa. Males patrol all day about the canopy of plants, usually 1/2 m to 2 m above ground, to seek females, often changing direction or going up or down to dip into nooks and follow the canopy, and they also patrol through the Cirsium arvense stand between the plants about 1/3 m above ground. Patrolling males that meet each other may zigzag together for a short distance, or chase rapidly briefly, or circle about each other briefly, before separating. Males fly faster than females; females usually rest on vegetation (commonly 1/3 m above ground), and have a slower more fluttery flight than males, while ovipositing females hover, and hover between plants under the canopy and hover into the shade beneath trees and shrubs (all eggs were laid about 10-40 cm above ground, commonly ~15-20 cm). In unsuccessful courtship, the male pursues the female, both hover for 1-10 sec, she lands if she was flying, she flutters her spread wings for 1 sec or longer (the wings varying from ~45-70° from vertical during each stroke--both sexes keep wings mostly spread during courtship), and the male lands behind her and may also flutter his wings the same way and may bend his abdomen to attempt to mate. Female wing fluttering is a rejection dance. Unreceptive females often fly fast to try to escape from the male, after hovering next to him briefly or after being courted on a plant. A mating pair was seen at 15:07; the female of the pair flew when disturbed. One male had a sparrow beak mark on a forewing, and 3 males were caught in spider webs.

Megathyminae
Megathymini

Megathymus streckeri streckeri (Skin.). 4 eggs on leaves of young Yucca sp. plants, SW Villa Grove, Saguache Co. Colo., June 17 & 19, 1966.

Megathymus streckeri texanus B. & McD. 9 eggs on leaves of young Yucca glauca plants, near Maysville, Chaffee Co. Colo., June 14 & 19, 1966. Oviposition 12:00 on Yucca elata (introgression with glauca) (W), Ute Lake State Park, Quay Co. New Mex., May 14, 1985. Adults assoc. with Y. elata (introg. glauca) (W), 5-6 mi SE Logan, Quay Co. New Mex., May 14-26, 1985. On grass clumps the uns is camouflaged, but adults often bask on old Yucca flower stalks, where the yellow-rimmed black hindwing uppersides resemble old opened seed pods.

Megathymus beulahae gayleae S. T. & S. Larvae from Agave striata falcata reared to adults, 73 mi. N Saltillo, Coahuila, Mex., Sep. 19-20, 1969. Larvae make cigar-shaped tents as do M. yuccae and M. ursus. MATURE LARVA cream, top of A10 (suranal plate) dark-red-brown, collar red-brown down the middle, with a paler-brown middorsal line (no blackish-brown lateral sclerite just below collar); head dark-red-brown, with an inverted Y-shaped mark consisting of cream along coronal sulcus and cream lateral to the adfrontal cleavage lines, this mark widest near the junction of the sulcus and cleavage lines and very narrow at the 3 extremities of the mark.

Megathymus ursus violae S. & T. Larvae raised Yucca sp., Franklin Mts., Tex., March 23 & April 1-2, 1969. Half-grown/older larvae hibernate. MATURE LARVA creamy-yellowish-white, top of A10 (suranal plate) dark-red-brown, collar red-brown down the middle, partially divided middorsally (no blackish-brown lateral sclerite just below collar); head dark-red-brown, with an inverted Y-shaped mark consisting of cream along coronal sulcus and cream lateral to the adfrontal cleavage lines, this mark widest near the junction of the sulcus and cleavage lines and very narrow at the 3 extremities of the mark.

Megathymus yuccae coloradensis Riley. Larvae in Yucca sp., Rito Alto Creek, Saguache Co. Colo., July 19, 1970, and at Little Rock, Los Angeles Co. Calif., April 15, 1972, and near Benson, Cochise Co. Ariz., April 17, 1972. Larvae hibernate. HALF-GROWN LARVA (Colo.) cream, top of A10 (suranal plate) dark-red-brown (no middorsal line), collar blackish-brown, a blackish-brown lateral sclerite just below collar; head red-brown.

Aegialini

Aegiale hesperiaris (Walk.). Larvae in leaves (trapdoors on underside of leaf) of mature Agave americana plants, Sierra de la Gavia N Saltillo, Coahuila, Mex., Sep. 19, 1969.

Agathymus polingi (Skin.). Larvae in leaves of Agave schottii (trapdoors on underside of leaf), Molino Basin, Pima Co. Ariz., Sep. 30, 1969.

Agathymus hoffmanni (F.). Larvae in Agave americana leaves (trapdoors on underside of leaf), Sierra de la Gavia N Saltillo, Coahuila, Mex., Sep. 19-20,

- 1969.
- 110 Agathymus neumoeni neumoeni (Edw.). Larvae raised from Agave parryi, W of Jerome 5600', Yavapai Co. Ariz., Sep. 29, 1970.
- Agathymus neumoeni chisosensis (F.). Trapdoor seen on Agave sp. (the large gray species; S), Green Gulch, Chisos Mts. Tex., Sep. 24, 1969.
- Agathymus alliae (S. & T.). Many larval holes (mostly on upperside of leaf) and 3 trapdoors (whitish, on underside of leaf), burrows ~4-5 cm long, all on Agave utahensis, W Mountain Pass, Ivanpah Mts., San Bernardino Co., Calif., Oct. 3, 1969. 13 trapdoors seen on Agave utahensis leaves (trapdoors on underside of leaf), Timp Point, Coconino Co. Ariz., Aug. 15, 1980. 13 trapdoors seen on A. utahensis, Crazy Jug Point, Coconino Co. Ariz., Aug. 17-18, 1980. EGG light-olive-green when laid, by the next day dirty-yellow sweeps over egg from the side (or starts with a dirty-yellow stripe across egg), by 2-3 days egg is dull-red with paler micropyle, after ~8 days upper half becomes dark-red (lower half still dull-red), by ~11 days becoming silky-bluish-gray (some have a small black patch or a darker-gray periphery) apparently because larva develops within. MATURE LARVA larva cream, a small black spot at position of each primary seta, top of A10 (suranal plate) black, collar black with a middorsal pale line, a black lateral sclerite just below collar; head red-brown, coronal sulcus and adfrontal cleavage lines tan. PUPA chitin-brown, with lateral brown spots on abdomen.
- Agathymus mariae mariae (B. & B.). Larvae raised from Agave lecheguilla leaves (trapdoors above leaf), N Van Horn Tex., Sep. 26, 1969, and N of Bracketville Tex., 21 Sep. 1969, and W of Dryden Tex., Sep. 22, 1969 and Sep. 18, 1970, and Langtry Tex., Sep. 1970, and NW of Boquillas Can. Tex., Sep. 23, 1969, and S of Shafter Tex., Sep. 24, 1969, and W of Lajitas Tex., Sep. 24, 1969, and S of Marfa Tex., Sep. 25, 1969. MATURE LARVA bluish-cream, top of A10 (suranal plate) red-brown, collar blackish-brown with a tan middorsal line, a blackish-brown lateral sclerite just below collar; head red-brown, coronal sulcus and adfrontal cleavage lines tan. PUPA chitin-brown.
- Agathymus remingtoni "valverdiensis" F. (a weak ssp. or synonym; estelleae [S. & T.] is also a ssp.). Larva raised A. lecheguilla leaves (trapdoors on upperside of leaf), N of Bracketville, Tex., Sep. 21, 1969.

Hesperiinae

Ancyloxypha numitor (Fab.). Oviposition 8:58 she landed and laid egg on leaf top of mostly-vertical Phalaris arundinacea leaf (P. a. 0-100, Agropyron [Elytrigia] repens 5-100, Bromus [Bromopsis] inermis 20-100); 2 eggs and 1 eggshell found on Bromus (Bromopsis) inermis (B. inermis 0-100, Poa pratensis 2-100, Agropyron [Elytrigia] repens 30-100, Phleum pratense 100); 1 egg found on Phalaris arundinacea; 1 egg and two 1st-stage larvae found on Agropyron (Elytrigia) repens (A. r. 0-100, Bromus [Bromopsis] inermis 20-100); 2 eggs found Agropyron (Elytrigia) repens (A. r. 0-100, Bromus [Bromopsis] inermis 20-100); 2 eggs found Agropyron (Elytrigia) repens (0-100, Bromus [Bromopsis] inermis 15-100); most eggs found on leaf underside, sometimes on vertical leaves, 1st-stage larvae live in rolled leaf tip; NE Conger, Freeborn Co. Minn., June 18, 1991. Preoviposition 11:05 Agropyron (Elytrigia) repens, NE Conger, Freeborn Co. Minn., June 17, 1991. Oviposition 10:38 Agropyron (Elytrigia) repens vertical leaf (A. r. 0-100, Bromus [Bromopsis] inermis 25-100); same female oviposited 10:39 Agropyron (Elytrigia) repens vertical leaf (A. r. 0-100, Bromus [Bromopsis] inermis 60-100); oviposition 10:44 Phalaris arundinacea vertical leaf (P. a. 0-100, Bromus [Bromopsis] inermis 20-100); oviposition 13:30 near-vertical Phalaris arundinacea leaf upperside; 5 eggs found (3 upperside 2 underside) on Phalaris arundinacea mostly on vertical leaves (P. a. 0-100, Bromus [Bromopsis] inermis 5-100); egg found Phalaris arundinacea leaf upperside (P. a. 0-100, Agropyron [Elytrigia] repens 20-100, Bromus [Bromopsis] inermis 0-100); eggshell found on Phalaris arundinacea; 1 1st-stage larva found on Phalaris arundinacea in rolled leaf tip; NE Conger, Freeborn Co. Minn., June 20, 1991. 3 eggs found on near-vertical leaves of Agropyron (Elytrigia) repens; 4 1st-stage larvae found on Agropyron (Elytrigia) repens in rolled leaf tips; preoviposition 12:30 Agropyron (Elytrigia) repens; female ignored Digitaria sanguinalis after inspecting it a bit; NE Conger, Freeborn Co. Minn., June 21, 1991. 1 egg found on leaf upperside of Echinochloa crusgalli; 3 eggs found on Agropyron (Elytrigia) repens leaf uppersides; NE Conger, Freeborn Co. Minn., June 22, 1991. At NE Conger, other grasses searched for numitor were: much Phleum pratense, some Setaria faber, Avena fatua var. sativa, Digitaria sanguinalis, Dactylis glomerata. HOSTPLANTS: Agropyron (Elytrigia) repens, Phalaris arundinacea, Bromus (Bromopsis) inermis, Echinochloa crusgalli are all hosts. Obviously A. numitor is a member of the hay-feeding guild, all the hosts being wide-leaf rather tall grasses, rather than turf grasses or bunch grasses.

the only non-hay grass among published hostplants is Poa, which I think is an 111 error (all references to Poa are based on A. Shapiro 1966, Butterflies of the Delaware Valley, Phil.: Amer. Ent. Soc.); most of my records were recorded near a Poa pratensis lawn, and the females showed absolutely no interest in the lawn, and sped across it to oviposit on taller hay grasses under shrubs, beside a house, along roadsides, in roadside ditches, and at the edge of a soybean field. NEST: 1st-stage larvae live in a rolled-leaf nest near narrow leaf tips, and eat the leaf basal to and sometimes beyond the nest; older larvae live in rolled-leaf nest. Egg pale-orangeish-yellow when laid, developing tiny red spots (except on top) which enlarge and mostly coalesce into a red blotch around most of sides, so overall appearance of egg becomes orange; egg elliptical in dorsal view, lower edge rounded without a flange. 1ST-STAGE LARVA light-yellow; collar & head black. 3RD-STAGE LARVA light-grass-green, heart slightly darker; collar and head black. MATURE LARVA green, slightly lighter next to the dark-green heart-line, collar black on posterior half and white on anterior half (a brown subdorsal spot is near lateral end of white half), 5th-stage has wax glands on A5678 (the only Hesperinae I know that has wax glands on any segments other than A78); head black with weak ochre stripe along coronal sulcus, ochre around rim of face in anterior view, an ochre spot medioventral to eyes. PUPA yellow-cream, wings & proboscis & appendages tan (but proboscis black-brown near wingtips & beyond wings), head & T1 blackish-brown except outer part of eye orange-brown & base of orbit tan, front of T2 blackish-brown with bluish-bloom, large brown subdorsal areas on T2-A6 (& weak on A78) are connected in broad longitudinal bands (which are blackish and near middorsal axis on T2), large brown lateral areas on A456 (weaker on A7), anal margin of wing dark-brown, wing veins dark-brown distally, A9-10 top red-brown, tarsi & distal 1/2 of antenna checkered, proboscis extends beyond wings about to end of A5, setiferous bump near proboscis on A5 & A6 (a black-brown or orange-brown spot beside it on A5), a ridge (interrupted ventrally, supraspiracularly & subspiracularly) circles abdomen on A5678 (ridge strongest on A78), subdorsal lenticles on T1 A12789 (tiny or absent on A34), cremaster very wide like a duckbill; wings and antennae turn orange before hatching. HIBERNATION STAGE: 8 mm long larva (~4th-stage); five larvae this size diapaused and refused to feed in lab.

Oarisma garita (Reak.). Oviposition 10:09 on Poa aquassizensis (W), Red Rocks, Jefferson Co. Colo., June 25, 1978. Oviposition Poa pratensis (F), Central Plains Experiment Station, Weld Co. Colo., June 20, 1976. Oviposition 10:00 Agropyron (Elymus="Sitanion") longifolius ("Sitanion hystrix") (B), Round Mtn., Custer Co. Colo., July 15, 1969. Oviposition 10:15 probably Muhlenbergia filiculmis (previously misidentified as Blepharoneuron tricholepis [B]), 2 mi. NE Rosita, Custer Co. Colo., July 14, 1970. Oviposition 10:15 Stipa robusta (previously misidentified as S. columbiana [B]), Bull Domingo Mine, Custer Co. Colo., July 9, 1969. Oviposition 12:02 (egg pale green) on underside of leaf of small Bouteloua (Chondrosium) gracilis plant (B. gracilis was also nearby and was 20-30% of nearby grasses, Koeleria macrantha [W] was 5 cm from egg and ~50% of grasses, Stipa comata [W] 10-15 cm from egg and ~20% of grasses), Guy Hill, Jefferson Co. Colo., June 25, 1986. Egg (#77) found on Bouteloua gracilis (B. gracilis thick 0-1 m, Stipa comata 28, 50, 60, 80, 1 m, Koeleria macrantha 28, 40, 70, Oryzopsis exiguua 28, Carex probably pennsylvanica heliophila 60-1 m), egg (#78) found on Bouteloua gracilis (B. gracilis 0-1 m, old Bromus [Anisantha] tectorum a few 40 cm, Stipa comata 75, 80), both eggs reared to pupae, N Beaver Brook, Jefferson Co. Colo., June 22, 1988. Oviposition 11:13 (#93) Stipa comata (S. comata 5, 8, 15, 15, 20, 25, 25, etc. onward, Poa pratensis thick 4 cm-1 m, Bouteloua gracilis 10-35, Agropyron [Elymus="Sitanion"] longifolius 70, 80), Guy Hill, Jefferson Co. Colo., June 27, 1988. Preoviposition 11:40 Bromus (Bromopsis) inermis, Wheatridge, Jefferson Co. Colo., July 13, 1988. Oviposition 11:46 and a second egg found 40 cm away, both on underside of Bromus (Bromopsis) inermis leaves (B. inermis common nearby, Poa pratensis scattered in understory 20 cm onward), eggshell (sucked dry by some Hemiptera) found on underside of Bromus (Bromopsis) inermis leaf (B. inermis thick all over, Dactylis glomerata 25 small plant, small sedge common 5 cm onward, Poa pratensis fairly common in understory 5 cm onward, Phleum pratense 1 m), egg found on underside of young Bromus (Bromopsis) inermis leaf (B. inermis thick all over, small sedge 30, 30, Agropyron [Elytrigia] repens 30, 60, scattered, Poa pratensis common all over in understory, Phleum pratense 80), Wheatridge, Jefferson Co. Colo., July 15, 1988; at this locality, O. garita occurs only in one meadow dominated by Bromus (Bromopsis) inermis, where females spend most of their time just resting, and males rest and patrol, so adults must have very small movements here. 1 egg found on Bouteloua gracilis leaf (B. gracilis common 0-1 m, Stipa comata 15-100 cm, Sporobolus cryptandrus 40-100 cm, Bromus tectorum scattered 5-100 cm, Carex probably pennsylvanica heliophila 40-100 cm),

Falcon County Park, Jefferson Co. Colo., June 15, 1989. Egg found on Bouteloua gracilis (B. gracilis common 0-100, Bromus japonicus scattered 5-100, Stipa comata common 40-100, Aristida purpurea 45, 45, 50, Andropogon gerardii 50-100, 55-200, Bouteloua curtipendula 35-100, Bromus tectorum scattered 10 cm onward), Chimney Gulch, Jefferson Co. Colo., June 27, 1989. Egg found on Stipa comata (S. comata 25 cm away, Agropyron [Elymus="Sitanion"] longifolius abundant 8 cm onward, Bromus tectorum 1, 3, 5-100, Festuca saximontana 20, 30-40, Danthonia parryi 45-65, Bouteloua gracilis 15, 25-100, Koeleria macrantha 60, 85), Guy Hill, Jefferson Co. Colo., June 19, 1989. Oviposition 12:01 on Stipa comata (S. comata 10, 10, 10, 20, 20, etc. common to 100, Carex perhaps foenea [no inflorescence] abundant 2-100, Agropyron [Pascopyrum] smithii 60), (before laying this egg she landed on Stipa comata 3X and bent abdomen but refused to lay, she did not land on Carex perhaps foenea, and ignored ?Poa agassizensis), NE Hayden, Routt Co. Colo., July 6, 1989. Oviposition 11:55 under Poa agassizensis leaf (P. agassizensis abundant 0-100 cm, Stipa viridula 50, 50, 90, Koeleria macrantha abundant 8-100, Agropyron [Elymus, "Elytrigia"] albicans 75-120, Carex probably pennsylvanica heliophila 20); oviposition 11:57 under Carex probably pennsylvanica heliophila (C. p. heliophila abundant 0-100, Stipa viridula 3, 10-80, 20-30, 50-55, 90, Koeleria macrantha abundant 4-100, Poa agassizensis 15, 25, 30, 70-80, Agropyron [Pascopyrum] smithii 100); oviposition 11:58 on Koeleria macrantha (K. macrantha abundant 3-100, Carex probably pennsylvanica heliophila abundant 10-100, Stipa viridula 70, Poa agassizensis 20, 20, 30, 40, 50-60 etc.); Green Mtn., Jefferson Co. Colo., June 22, 1989. Oviposition 12:50 on underside of Agrostis gigantea leaf (A. gigantea common 0-100, Poa pratensis abundant 0-100, Scirpus americanus ["Schoenoplectus pungens"] scattered 10, 20, etc., Juncus alpino-articulatus 20, Eleocharis palustris very abundant 0-100), near Fort Collins, Larimer Co. Colo., July 5, 1989. Egg found under Agropyron (Elytrigia) repens leaf (A. [E.] repens common 0-100, Bromus (Bromopsis) inermis common 20-100, Poa pratensis 15-100, Agrostis gigantea 40), Wheatridge, Jefferson Co. Colo., July 11, 1989. Adults common in Agropyron (Pascopyrum) smithii swale, Falcon County Park, Jefferson Co. Colo., June 7, 1989. Preovipositions 10:05, 11:30, on Poa pratensis; oviposition 10:09 Carex prae-gracilis (10 cm above ground on underside of 2-mm-wide blade tip) (C. prae-gracilis 0-100, Agrostis gigantea 100, Festuca pratensis 2-100, Poa pratensis 5-100, Hordeum [Critesion] jubatum 70-100); oviposition 10:36 Agropyron (Elytrigia) repens (15-20 cm above ground on 0.8-mm-wide leaf tip) (A. repens 0-100, Poa pratensis 30, 30, 80, 90, Agrostis gigantea 60, Carex stipata 40-60, 60-90, 70-90, Carex prae-gracilis 45, 70, 80); Wheatridge, Jefferson Co. Colo., July 3, 1990. Oviposition 12:12 Carex lanuginosa leaf underside (10 cm above ground on 3-mm-wide leaf, 30 cm from leaf tip) (C. lanuginosa 0-100, Poa pratensis 0-100, Agrostis gigantea 8, 20, Agropyron [Elytrigia] repens 5-100); Wheatridge, Jefferson Co. Colo., July 14, 1990. Egg found Poa pratensis (P. pratensis 0-100, Danthonia parryi 20, Carex 20); egg found P. pratensis (only grass nearby); Fraser, Grand Co. Colo., July 31, 1990. Eggshell found P. pratensis; egg found P. pratensis (P. pratensis 0-100, Festuca idahoensis 40, 40, 50, Deschampsia caespitosa 70); egg found P. pratensis (0-100, Agropyron [Elymus] trachycaulum 30, 30, 30, long round-leaf rush 40-100); egg found P. pratensis (0-100, Agropyron [Elymus, ="Sitanion"] longifolius 100, Agropyron [Elymus] trachycaulum 100, Carex ?prae-gracilis 5-100); egg found P. pratensis (0-100, Festuca idahoensis 35, 40, 50, etc., tall round-leaf rush 10-100); Fraser, Grand Co. Colo., Aug. 1, 1990. All eggs were found 2-4 cm below leaf tips. Egg found P. pratensis (P. pratensis 0-100, Festuca idahoensis 0-100, Stipa viridula 17, round-leaf rush 0-100); egg found Poa pratensis (P. pratensis 0-100, Poa arida or young P. pratensis near egg, Phleum pratense 15, Deschampsia caespitosa 15, Agropyron [Elymus, ="Sitanion"] longifolius 40, 60, Carex ?prae-gracilis 5-100, round-leaf rush 0-100); Fraser, Grand Co. Colo., Aug. 2, 1990. Hollow egg (sucked dry) found on Agropyron (Elytrigia) repens (~15 cm above ground on 4-mm-wide leaf underside) (A. repens 0-100, Poa pratensis 2-100); Wheatridge, Jefferson Co. Colo., Aug. 11, 1990. HOSTPLANTS: 35 eggs or ovipositions were found in nature, scattered among 12 hosts: Poa pratensis 10, Bouteloua gracilis 5, Bromus (Bromopsis) inermis 4, Stipa comata 3, Agropyron (Elytrigia) repens 3, Poa agassizensis 2, Agropyron (Elymus="Sitanion") longifolius 1, Muhlenbergia filiculmis 1, Stipa robusta 1, Agrostis gigantea 1, Koeleria macrantha 1, Carex probably pennsylvanica heliophila 1, Carex prae-gracilis 1, Carex lanuginosa 1. Lab larvae ate Poa pratensis well, Carex nebraskensis well (several larvae grew only on it from half-grown to pupation), Carex pennsylvanica heliophila well. These 12 hosts include turf grasses, bunchgrasses, hay grasses, and sedges. Considering that the hosts with the most records were plants that were deliberately searched for eggs (thus artificially increasing the number of records), I conclude that O. garita chooses a wide

variety of grasses and sedges, short and tall, narrow- and wide-leaved, clumped and nonclumped; clearly it is the most polyphagous monocotyledon-feeding skipper known. O. garita is common in thick-grass swales and slopes dominated by Poa agassizensis, so this grass may be the most common host in the foothills. NO NEST: Larvae, from young to mature, do NOT make silk nests, which is very unusual in HesperIIDae; this behavior exposes larvae to predation, which may be why larvae have stripes like those of Oeneis, which tend to camouflage the exposed larvae from predators (nearly all nest-building HesperIIDae larvae are unstriped, though Heteropterinae have a stripe and make nests). The lack of nest building also allows larvae to eat many different kinds of grasses, because the leaf nests of most HesperIIDae are adapted to a certain type of grass (such as a rolled-leaf-tube on a broad-leaf grass, or a silk tunnel in the litter & soil at base of a narrow-leaf bunchgrass). HIBERNATION STAGE undoubtedly half-grown larva (no diapause in lab). EARLY STAGES (Beaver Brook): EGG green, small in size, hemispherical in lateral view with acute angle between lower walls and base, an odd asymmetrical oval shape in dorsal view. FIRST-STAGE LARVA when first hatched yellowish-cream, becoming greenish-cream, with a cream band near middorsal, a cream dorsolateral line, a faint cream line above spiracles, a cream line on subspiracular ridge; head ochre-yellow or pale tan with a thick light-brown mark on front shaped like a normal-distribution. First-stage larva after feeding green (darker in middle of body), with 5 white subdorsal to lateral lines (#1, 3, 5 wider than #2, 3), two broad whitish-green sublateral bands, A10 often greenish-tan; head ochre-yellow or greenish-tan with bell-shaped mark on lower front. HALF-GROWN LARVA green covered with black dots, from top to side a middorsal dark-green band (a very narrow whitish line down its center) edged by a white line, 6 whitish lines (narrow, medium, narrow, medium, narrow, wide), a lateral pale-yellow line edged by dark-green, a single wide A10 tail; head green, covered with black dots, eyes cream. MATURE LARVA green, a wide middorsal dark-green band with a very narrow white line down its center, then a medium-width white band, a medium-width greenish-white band edged above by a very narrow green line, a narrow greenish-white band edged above & below by a dark-green line, (only the above bands & lines extend onto A9-10), a medium-width whitish-green band, a greenish-white line edged above & below by a green line, a wide band (light-green above the ochre-tan spiracles, green below them), a white lateral ridge edged by green, underside of larva green, the A9-10 rear tapered into a duckbill terminated by brown posteriorly-directed hairs; head tan-green. PUPA cloudy (with whitish-green areas)-green, head horn ~1.5 mm with pinkish-tan tip, tip of proboscis red-brown, proboscis extends beyond wings ~1.5 mm to A5-6 joint, cremaster translucent-whitish with reddish-brown crochets, head and distal half of wings whitish-green, T2-A8 have the same bands and lines as larvae, including 1 very narrow white middorsal line on abdomen, then 1 wide white subdorsal line, 2 medium-width yellow-white lines (the upper more diffuse), 2 narrow yellow-white lines (the upper also more diffuse), 1 broad yellowish-green band with spiracles, 1 narrow yellow-white lateral line, the underside cloudy-(whitish)-green.

Hylephila phyleus muertovalle Scott. Oviposition 10:00 on "lawn grass", Wellman Hall, University of California, Berkeley, Calif., Oct. 22, 1971.

Yvretta rhesus (Edw.). Preoviposition Bouteloua (Chondrosium) gracilis, Central Plains Experiment Station, Weld Co. Colo., June 11, 1976. Egg found on Bouteloua gracilis (B. gracilis very common 0-100, Buchloe dactyloides 25-100, Agropyron [Pascopyrum] smithii 10-100, Bromus japonicus dead 5-100, live 45, Stipa viridula 90, Bouteloua curtipendula 55, 100, ?30, Aristida purpurea 70); Horsetooth Res., Larimer Co. Colo. May 26, 1990. Egg found on Bouteloua gracilis (B. gracilis sward 0-100, Agropyron [Pascopyrum] smithii 5-100, Vulpia octoflora 15, 50, 50, 100, Buchloe dactyloides 5-100); egg found on Bouteloua gracilis (B. gracilis 0-100, Agropyron [Pascopyrum] smithii 7-100, Bromus japonicus dead 40, Buchloe dactyloides nearest plants 2 m away); Horsetooth Res., Larimer Co. Colo. May 28, 1990; all 3 eggs at this site were about 2-3 cm above ground, on top of or near the top of tiny little plateaus in a broad valley bottom. Egg found Bouteloua gracilis (common 0-100 cm, Carex pennsylvanica heliophila 5-100 cm, Aristida 50, 100, 100, Andropogon scoparius 100 cm), N-facing slope near swale, Lowry Bombing Range, Arapahoe Co. Colo., May 19, 1991. At the Horsetooth Res. locality I first thought that Buchloe dactyloides is the hostplant because adults often land on large patches of this plant, which has rhizomes and spreads outward to form pure patches up to 2-5 m wide; this plant resembles Bouteloua gracilis in its turflike growth habit and identical hair-comb ligules, but I found that B. dactyloides can be easily identified in the field (with a hand lens or sharp eyes against a dark background) by its pilose leaves (glabrous in B. gracilis); careful identification revealed that B. gracilis formed about 40% of the short turfgrass

at this site, B. dactyloides 50%; and all three eggs were found (about 8 hours of searching produced 3 eggs) on B. gracilis even though I searched about four times more B. dactyloides (although B. dactyloides leaves often curl laterally so an egg could be hidden beneath a leaf and thus be hard to see); therefore I think B. gracilis is the main hostplant, although B. dactyloides could be occasionally eaten; as further proof, B. gracilis is associated with the species in S. Colo. (where B. dactyloides is uncommon), and B. gracilis is a better hostplant because it is mostly green from spring to fall (even in Oct.), whereas B. dactyloides is yellowish-green even in late May and has half its leaves brown by the end of summer, and all the leaves are typically narrower and are only 1/2 to 2/3 the length of B. gracilis leaves (causing hotter drier conditions for larvae). Larvae no doubt live in silk tubes among the lower leaves and soil, as do Hesperia, because I have never seen an aerial nest on B. gracilis. Mature larvae hibernate. EGG whitish-green (pale green), no color change. FIRST-STAGE LARVA yellowish-cream, turning greenish-yellowish-cream after feeding, heart blue-green, A10 with 2 short 2 long setae, the shiny collar is black on margins but dull-gray in center, between collar and neck light-brown; head black. 2ND-STAGE LARVA greenish-cream; head & collar black. 3RD-STAGE LARVA similar. 4TH-STAGE LARVA similar to mature larva, light-gray-green, heart-band slightly darker on A4-8, intersegmental areas pale yellow-cream, lateral ridge yellow-cream (faintly tan on A6-10), top of A10 has a middorsal brown stripe and a supralateral brown stripe, collar black; head as in mature larva. MATURE LARVA light-gray-(slightly-bluish)-green (some larvae are much redder, being brownish-green, but brownish-red sublaterally and posteriorly [brownish-red on top of last few abd. segm.]), heart-band slightly darker on A4-8, intersegmental areas pale-yellow-cream, lateral ridge (below spiracles) yellow-cream from T3-A9 and suffused with reddish-tan in middle of each segment, A8-9 (and A7 somewhat) suffused with tan, neck translucent gray, front of T1 greenish-cream, collar black (but has a short pale-green vertical streak starting from lateral end near rear---this streak faint on 4th stage), a small black oval sclerite anterodorsal to T1 spiracle, spiracles black, top of A10 has a brown middorsal stripe and a brown oblique supralateral stripe, numerous tiny setae with blackish bases, legs black, top of A10 gray with black middorsal stripe and black supralateral stripe; head black, a cream vertical stripe along coronal sulcus, cream adfrontal areas, & a cream crescent in front of eyes 3-6 & a cream spot behind them form the ventral edge of a gray flush covering most of face. PUPA (deformed) thorax pale-green tinged with brown, abdomen pale-creamy-green with cream clouds visible inside body, A4-7 more chitin-tan on rear, heart-band green on abdomen, T1 spiracle dark chitin-brown, cremaster chitin brown.

Stinga morrisoni (Edw.). 2-cm-long larva found in tube of ~6 Stipa scribneri leaves (15 cm above ground on 30-cm-tall clump); 2-cm-long larva found on S. scribneri in tube of ~5 leaves (10 cm above ground on 20-cm-tall plant); 4 empty nests found on S. scribneri (one nest of ~4-5 leaves 1/3 up on 30-cm-tall clump); empty fresh leaf tube of ~5 leaves was ~20 cm above ground on 30-cm-tall Stipa scribneri clump and a red wasp was in clump below nest, I searched clump and found a ~2-cm-long larva in base of clump wedged in among last year's dead culm bases ~8 cm from nest, larva may have been parasitized as 1 of the 3 larvae found at site produced wasps (or possibly heavy hail and rain the night before drove the larva out of the nest); empty nest with ~2nd-stage-larval head capsule found, and 3 other empty nests found, all on S. scribneri; the mature larvae died in hibernation, but are Stinga based on larval color pattern, mature larval hibernation, the A7-8 ventral powder glands, and grass host; all were on ridgetop and on N-facing slope just N of hilltop, in sun between Pinyon Pine trees on N-facing slope and NW-sloping ridge, or in partial shade under Pinyons there and on ridgetops; Bear Creek, Chaffee Co. Colo., Aug. 21-22, 1990.. Stipa scribneri common but no nests or larvae seen; Cotton Creek, Saguache Co. Colo., Aug. 22, 1990. Silked-leaf nest (of Stinga?) found on ?Stipa scribneri?; Stove Mtn., ~9900', El Paso Co., Colo., June 23, 1990. 2 eggs (1 under green leaf, 1 under dead straw-colored leaf) found on Stipa scribneri clump (10 & 15 cm from Oryzopsis exiguu) on hilltop; Stipa scribneri occurred only on ridgetops; Cheesman Peak, Jefferson Co. Colo., June 10, 1991. No eggs found on Andropogon gerardii or Andropogon scoparius, W Deckers, Jefferson Co. Colo., June 12, 1991. Mature larvae hibernate. Stipa scribneri grows on ridgetops and just north of ridgetops where there is shade at least part of the day, commonly under the canopy of Pinyon or juniper trees. It is very common in the Arkansas Canyon and hills around the San Luis Valley, where it is the commonest non-riparian "hay" (wide-leaf) grass, and seems to be the main hostplant, and Stinga is also fairly common there. S. scribneri is fairly common in the lower Wet Mts. foothills, where Stinga is scarce. But in the Front Range S. scribneri is very local (florists call it "rare", though it is common on top of the Dakota Sandstone

hogback at the edge of the plains, fairly common in the South Platte River canyon [on ridges NE Foxton, Reynolds Park, W Deckers, etc.], and I have also found a few plants at Mt. Vernon Historic Site, ridge S Chimney Gulch, ridge N Ralston Butte); Stinga is also rare in the Front Range (but was very common one year in S Platte Can.). I have not found S. scribneri on ridges at Tintown and Crawford Gulch where Stinga occurs (is rare), and so far Stinga has not been found on the Dakota Hogback where S. scribneri is common, so there may be additional hosts in the Front Range, the most likely being Agropyron (Leymus) ambiguus. Mature larvae hibernate, and refuse to feed further or pupate in lab and eventually die. Early stages (based on larvae found in nature, and reared from eggs laid by females from near Deckers and reared to mature larvae): EGG cream, hemispherical but definitely oval (asymmetrical) in dorsal view and very rounded on the bottom edges (this shape easily distinguishes the egg from other Colo. Hesperinae) and somewhat flat on the very top. FIRST-STAGE LARVA cream, a narrow black collar; head black, 0.6 mm wide. OLDER AND MATURE LARVA (reared from eggs and from nature) tan (slightly pinkish-tan on A7-9 and the rear of A6, with wide darker gray-tan internal subdorsal areas, somewhat translucent so that faint grayish subdorsal areas appear and most larvae are somewhat dark-greenish except near head and on rear, heart dark-gray-tan, collar very narrow & black posteriorly, collar translucent tan on anterior 40%, top of A10 brown, a lateral silvery streak of internal tracheae is visible through the translucent

exoskeleton; head blackish-brown; the semi-translucent body distinguishes the larva from other Colo Hesperinae.

Hesperia. By searching for eggs in nature, I determined hostplant choice well for several Hesperia, especially H. juba, H. comma assiniboia, and H. leonardus pawnee in the foothills, and H. nevada in montane grasslands. Table 7 summarizes the hostplants found for H. juba, comma, leonardus pawnee, and nevada, and lists the grasses/sedges found at the habitats studied even when no eggs were found on them; the first three were studied at the same localities so the potential hostplants are the same, but H. nevada was studied at higher-altitude sites with some different grasses. The fall generation of H. juba prefers to oviposit on green Bouteloua (Chondrosium) gracilis leaves, dead Bromus (Anisantha) tectorum inflorescences, and dead Poa secunda var. sandbergii clumps, whereas the spring generation of juba chooses several green grasses (esp. Poa). H. comma assiniboia prefers Carex pensylvanica heliophila, but sometimes also oviposits on Bouteloua gracilis leaves and dead Bromus tectorum inflorescences, rarely on other grasses. High-altitude H. comma eat several Carex of the same shape as C. p. heliophila. H. leonardus pawnee prefers green Bouteloua gracilis and rarely other grasses (one female oviposited on a dead Bromus tectorum inflorescence above a Bouteloua gracilis clump). H. leonardus montana eats Bouteloua gracilis. H. nevada on the eastern slope of the continental divide prefers Festuca saximontana, sometimes Koeleria macrantha, less often Stipa comata; at western-slope sites Festuca idahoensis is chosen. H. uncas, H. pahaska, and H. viridis prefer Bouteloua gracilis, though the latter sometimes chooses Bouteloua curtipendula, rarely Andropogon gerardii. H. ottoe prefers Andropogon gerardii. The popularity of montane grasses is discussed under H. nevada. In the foothills, some Sept.-Oct. grasses are favorites of Hesperia, including Bouteloua gracilis which has wide green tender (but sometimes dry) leaves all season long (it is the favorite grass for low-altitude turfgrass-feeding butterflies and skippers in Colo.). Carex pensylvanica heliophila is also green and tender all summer and is preferred by Hesperia comma. Surprisingly, Hesperia juba and H. comma often oviposit on dead Bromus tectorum inflorescences (seed sheaths), and H. juba often oviposits on Poa secunda var. sandbergii clumps that are dead except for tiny green fall-emerging shoots; the explanation is that beneath these dead inflorescences and within the dead clumps are small green shoots that are actually the most tender grasses available in the habitat at the end of summer and early fall. Eggs laid on dead Bromus tectorum inflorescences and dead Poa secunda var. sandbergii clumps hatch, then larvae must crawl to the ground and feed on tiny green shoots that grow in fall and spring; these grasses are called "winter grasses". Most Sept.-Oct. grasses and sedges are shunned by Hesperia. Bouteloua curtipendula has wider leaves and is a good Hesperia host earlier in the summer, but in Sept.-Oct. most leaves are drying or are turning brown. Stipa comata is very common and grows in clumps but is almost never chosen apparently because the leaves are extremely tough. Sporobolus cryptandrus is common but never chosen apparently because it is turning brown and does not grow in clumps and has a single stalk for the lowest 10 cm of the stem (larvae prefer clumps because they provide more food and permit a silk tube nest to be constructed much easier in the plant base and upper soil--the exception, Bromus tectorum, is a single-stem

grass but it grows in dense patches on disturbed areas such as gopher diggings and rain-washed slopes where the inflorescences form a canopy shading the growing shoots). Aristida purpurea grows in clumps but is almost never chosen perhaps because of biochemical reasons, or perhaps the leaves are too fine (1 mm wide). Andropogon gerardii grows in clumps and is used for oviposition by many Hesperiinae in June-July, but is never chosen in Sept.-Oct. apparently because its leaves are mostly turning brown. Andropogon (Schizachyrium) scoparius grows in clumps but is seldom chosen apparently because it is turning brown by Sept. Agropyron (Elymus="Sitanion") elymoides ("Sitanion hystrix") grows in small clumps but is refused by Hesperia perhaps (?) because the leaves are fairly narrow and tough, although it was not searched much because it is uncommon. Agropyron (Pascopyrum) smithii does not grow in clumps and has very tough leaves; no eggs were found on it. Koeleria macrantha grows in clumps and has fairly tender 3 mm wide leaves but no eggs were found on it in the foothills although it was not searched much because it is uncommon there. Poa also received almost no eggs though it was not searched thoroughly; it generally grows in moister soils than the habitats that female Hesperia prefer.

Table 7. Summary of hostplants of four Hesperia. Numbers are eggs found on or oviposited on each plant. No eggs were found on some plants.

Hostplant	<u>Hesp.</u> <u>juba</u>	<u>Hesp. comma</u> <u>assiniboia</u>	<u>Hesp. l.</u> <u>pawnee</u>	<u>Hesp.</u> <u>nevada</u>
<u>Bromus</u> (<u>Anisantha</u>) <u>tectorum</u> (dead)	28	9	-2	--
<u>Bromus japonicus</u> (dead)	--	--	--	--
<u>Bromus</u> (<u>Bromopsis</u>) <u>inermis</u>	--	--	--	--
<u>Vulpia octoflora</u>	--	--	--	--
<u>Festuca saximontana</u>	--	--	--	97
<u>Festuca idahoensis</u>	--	--	--	8
<u>Festuca arizonica</u>	--	--	--	--
<u>Poa pratensis</u>	1	1	--	1
<u>Poa aquassizensis</u>	1	--	--	--
<u>Poa nemoralis interior</u>	--	--	--	--
<u>Poa compressa</u>	-2	--	--	--
<u>Poa secunda sandbergii</u> (dormant)	11	--	--	--
<u>Agropyron</u> (<u>Pascopyrum</u>) <u>smithii</u>	-1	--	--	--
<u>Agropyron</u> (<u>Elymus</u>) <u>elymoides</u>	--	--	--	--
<u>Agropyron</u> (<u>Elymus</u>) <u>longifolius</u>	--	--	--	--
<u>Agropyron</u> (<u>Elymus</u>) <u>trachycaulum</u>	--	--	--	--
<u>Agropyron</u> (<u>Leymus</u>) <u>ambiguus</u>	--	--	--	--
<u>Agr.</u> (<u>Elymus</u> , "Elytrig.") <u>albicans</u>	--	--	--	--
<u>Koeleria macrantha</u>	--1	--	--	28
<u>Danthonia parryi</u>	--	--	--	1
<u>Muhlenbergia montana</u>	--	--	--	--
<u>Sporobolus cryptandrus</u>	--	--	1	--
<u>Oryzopsis exiqua</u>	--	--	--	1
<u>Stipa comata</u>	1	1	--	16
<u>Stipa columbiana</u>	--	--	--	--
<u>Stipa viridula</u>	--	--	--	--
<u>Aristida purpurea</u>	2	--	--	--
<u>Bouteloua</u> (<u>Chondrosom</u>) <u>gracilis</u>	71	12	30	4
<u>Bouteloua curtipendula</u>	-2	5	3	--
<u>Andropogon gerardii</u>	--	--	--	--
<u>Andropogon</u> (<u>Schizach.</u>) <u>scoparius</u>	--	6	--	--
<u>Carex pensylvanica heliophila</u>	--	31	2	--
<u>Carex</u> sp.	--	8	--	--

Hesperia uncas Edw. Oviposition on Bouteloua (Chondrosom) gracilis, Bull Domingo Hills, Custer Co. Colo., July 3, 1969. Oviposition B. gracilis, Round Mtn., Custer Co. Colo., July 2, 1969. Oviposition B. gracilis, Bear Creek, Chaffee Co. Colo., June 26, 1969. Oviposition B. gracilis, Green Mtn., Jefferson Co. Colo., June 23, 1972. Preovipositions 4 times at 13:40 on B. gracilis and twice on Thlaspi arvense dried inflorescence, Green Mtn., Jefferson Co. Colo., Aug. 10, 1978. Preoviposition 11:25 on Bouteloua gracilis (bent abdomen but no egg laid), River Bend, Elbert Co. Colo., Aug. 7, 1989. 1 egg found on B. gracilis, reared on Poa pratensis, pupated ~ Aug. 20, female emerged Aug. 29, 1991; Midway, El Paso Co., Colo., June 8, 1991. EGG cream. 1ST-STAGE LARVA cream; collar & head black. MATURE LARVA slightly-brownish-gray on thorax and top of body, rest of body slightly-grayish-tan, heartline darker, a darker-

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brown lateral band on abdomen, legs black, collar black, edged anteriorly by white; head black, a cream line along coronal sulcus, a darker-cream streak on adfrontal area. PUPA translucent pale-olive-green on thorax head & wings (changing to greenish-cream on outer part of wings), most of head, eye, and anterior part of T2 mottled with black-gray, exposed tip of hindlegs and proboscis orange-brown, proboscis extends to anterior third of A6, T3-A1 orange-tan, A10 green-gray, rest of abdomen cream-tan, a green-gray sinuous middorsal band on abdomen, some slightly-darker supralateral and lateral and sublateral patches on abdomen, the usual hairy bump near midventral line on A456, cremaster orange-brown, rather long (with straight lateral margins) and fairly wide (H. juba also has a fairly long cremaster, whereas that of H. otloe and H. viridis is shorter so the lateral margins are convex), the crochets long and unhooked or only slightly hooked; pupa later becomes yellower, abdomen yellow-tan (light yellow-brown on top of abdomen and ventrally on A7-10) with prominent black spiracles, wings thorax orangish-tan, mouthparts light brown, the same dark mottling as before (plus middle of T2 now dark brown as well).

Hesperia juba (Scud.). Oviposition Poa pratensis, Fort Collins, Larimer Co. Colo., June 5, 1976. Oviposition (preoviposition?) 12:50 Poa agassizensis (W), 5 mi. SE Bailey, Park Co. Colo., May 31, 1977. Preoviposition, bent abdomen to Distichlis spicata var. stricta, Jones Hole, Dinosaur Nat. Mon., Utah, June 11, 1973. Preoviposition or oviposition 12:35 on dead Bromus (Anisantha) tectorum inflorescence and two eggs found on dead B. tectorum inflorescence stalks (in 30 X 50 cm patch of dead B. tectorum; Sporobolus cryptandrus [W] clump 15 cm away, Aristida purpurea [W] tiny clump 15 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 23, 1987. Oviposition (lot #1) 11:08 on dead Bromus tectorum stem (next to 15 cm rock), and 1 egg found on dead B. tectorum inflorescence, both in large B. tectorum sward downslope from Cercocarpus montanus bush (Stipa comata [W] several clumps 15-60 cm away, Bouteloua curtipendula uncommon 30 & 80 cm away, Sporobolus cryptandrus [W] rare 50 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 3 eggs (lot #2) found on dead Bromus tectorum inflorescences next to and near 20-cm-wide rock in B. tectorum sward in small clearing below Cercocarpus bush (Stipa comata 5 clumps 10-40 cm away, Sporobolus cryptandrus 5 clumps 70 cm away, Bouteloua [Chondrosum] gracilis 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 1 egg (lot #3) found on dead Bromus tectorum inflorescence in B. tectorum sward above 20-cm rock downslope from Cercocarpus bush (Bouteloua curtipendula 6 small clumps were at rock edge and 15-40 cm away, Stipa comata 4 clumps 10-25 cm away, Sporobolus cryptandrus 70 cm & 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 1 egg (lot #4) found on dead Bromus tectorum leaf above a 25-cm rock on B. tectorum sward downslope from Cercocarpus shrub (Agropyron [Pascopyrum] smithii var. molle [W] 30 cm away, Bouteloua gracilis 35 & 50 cm away, Stipa comata 40 & 40 cm away, Sporobolus cryptandrus 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 1 egg (lot #5) found on dead Bromus tectorum inflorescence in B. tectorum sward 5 cm from 30 X 15 cm rock downslope from Cercocarpus bush (Bouteloua curtipendula many clumps 2-40 away, Stipa comata 15 cm away, Sporobolus cryptandrus 40 cm & 1 m away, Andropogon (Schizachyrium) scoparius 60 cm away, Carex probably pennsylvanica heliophila 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. Egg (lot #6) found on dead Bromus tectorum inflorescence 5 cm above a 15 X 10 cm rock in big B. tectorum sward downslope from Cercocarpus bush (Stipa comata 5 clumps 5-50 cm away, Agropyron [Elymus, "Elytrigia"] dasystachyum (possibly trachycaulum) 3 clumps 30 cm away, Sporobolus cryptandrus 2 patches 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. Egg (lot #8) found on dead Bromus tectorum inflorescence clump 20 X 15 cm rock downslope from Cercocarpus bush in B. tectorum sward (Stipa comata common 5-70 cm away, Sporobolus cryptandrus several 60-70 cm away, Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. Oviposition (lot #12) 11:17 on dead Bromus tectorum inflorescence in B. tectorum sward 70-100 cm from Cercocarpus bushes (Sporobolus cryptandrus common 15-100 cm away, Agropyron [Elymus, "Elytrigia"] albicans [W] 2 small plants 20 cm away, Stipa comata clump 50 cm away), prior to this oviposition the female hovered over dead B. tectorum in several other clearings among Cercocarpus also (if the hovering female runs out of clearing she zooms over the bushes to the next clearing and hovers again), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #14) (with larva chewing its way out) found on underside of Bouteloua gracilis leaf below 20 cm rock in moderate Bromus tectorum sward downslope from Cercocarpus bush (B. gracilis was all around, Sporobolus cryptandrus 2 clumps 70-80 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #15) found on dead Bromus tectorum inflorescence beside 30 cm rock in thick B. tectorum sward Cercocarpus (H. juba often prefers to oviposit in clearings several meters wide between Cercocarpus bushes) (Stipa

comata 25-100 cm away, Sporobolus cryptandrus common 20-90 cm away, Bouteloua curtipendula 2 clumps 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #16) found on dead Bromus tectorum inflorescence amid rock pile in B. tectorum sward downslope from 2 Cercocarpus bushes (Carex probably pennsylvanica heliophila 3 clumps 15-30 cm away, Stipa comata common 25-100 cm away, Sporobolus cryptandrus 2 clumps 1 m away, Bouteloua gracilis 2 clumps 50-100 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #17) found on dead Bromus tectorum inflorescence in B. tectorum sward among big rocks downslope from Cercocarpus bush (Sporobolus cryptandrus common 30-100 cm away, Aristida purpurea clump 1 m away, Stipa comata 3 clumps 40-100 cm away, Carex probably pennsylvanica heliophila clump 40 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #21) found on dead Bromus tectorum inflorescence stalk above 20 X 15 cm rock in B. tectorum sward 3 m from Cercocarpus (Stipa comata common 10-40 cm away, Bouteloua curtipendula 4 clumps 20-100 cm away, Sporobolus cryptandrus 3 clumps 30-35 cm away, Bouteloua gracilis clump 80 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #25) found on dead Bromus tectorum inflorescence in B. tectorum sward above a 40 cm rock in Cercocarpus clearing on a SE-facing point of ridge (Andropogon gerardii 5 clumps 20-35 cm away, Stipa comata [W] common 25-100 cm away, Sporobolus cryptandrus [W] 5 clumps 25-50 cm away, dead Bromus japonicus Thunberg 2 dead shoots 30-50 cm away), Red Rocks, Jefferson Co. Colo., Sept. 30, 1987. Egg (lot #26) found on underside of Bouteloua gracilis leaf among large clump of it (dead Bromus japonicus dead 3 & 20 cm away, Stipa comata 2 clumps 40 cm away, dead Bromus tectorum 20 & 30 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. 2 eggs (lot #27) found on Bouteloua gracilis leaves in a 25 cm row of it (dead Bromus tectorum rare 5 cm away, dead Bromus japonicus occasional 10-30 cm away, Stipa comata common 20-100 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. 2 eggs (lot #28) found on Bouteloua gracilis (B. gracilis common 5-75 cm away, Stipa comata common 30-70 cm away, Aristida purpurea clump 60 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #29) found on Bouteloua gracilis (B. gracilis common 5-40 cm away, dead Bromus japonicus common everywhere, Stipa comata 2 clumps 5 & 70 cm away, Agropyron [Elymus="Sitania"] elymoides ["Sitania hystrix"] [W] 2 clumps 10-40 cm away, dead Bromus tectorum 30 cm away, Bouteloua curtipendula big clump 50 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #30) found on Bouteloua gracilis (B. gracilis common 20-70 cm away, Bouteloua curtipendula 3 clumps 45-50 cm away, Stipa comata 3 clumps 45-90 cm away, Agropyron [Elymus="Sitania"] elymoides ["Sitania hystrix"] 14 clumps 50-100 cm away, dead Bromus japonicus scattered all over, dead Bromus tectorum rare 20-60 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #31) found on Bouteloua gracilis 25 cm clump (B. gracilis 2 large clumps 20 & 30 cm away, dead Bromus japonicus scattered all over 15 cm onward, Agropyron [Elymus="Sitania"] elymoides ["Sitania hystrix"] 2 clumps 50 cm away, Bouteloua curtipendula clump 50 cm away, Stipa comata 2 clumps 50-85 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #36) found on Bouteloua gracilis (B. gracilis all over, dead Bromus japonicus uncommon 10 cm onward, Stipa comata 5 clumps 50-90 cm away, Bromus tectorum uncommon 2 cm onward), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #37) found on Bouteloua gracilis (B. gracilis common 5-100 cm away, Stipa comata common 25-50 cm onward, dead Bromus japonicus uncommon 10 cm onward, dead Bromus tectorum common 30 cm onward), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #38) with Trichogrammatid exit hole found on Bouteloua gracilis (B. gracilis all over, Stipa comata common 30-70 cm away, dead Bromus japonicus scattered all over 7 cm onward, dead Bromus tectorum scattered all over 7 cm onward, Aristida purpurea clump 90 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. 3 eggs (lot #39) (one with Trichogrammatid exit hole) found 30 cm apart on Bouteloua gracilis (B. gracilis thick, dead Bromus japonicus scattered 10 cm onward, dead Bromus tectorum scattered 10 cm onward, Sporobolus cryptandrus 2 clumps 40-100 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #40) found on Bouteloua gracilis (B. gracilis thick, dead Bromus tectorum scattered 10 cm onward, dead Bromus japonicus scattered 2 cm onward, Sporobolus cryptandrus 3 clumps 30-50 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. 2 eggs (lot #42) found on Bouteloua gracilis (B. gracilis thick, dead Bromus japonicus scattered, dead Bromus tectorum common 20 cm onward, Stipa comata common 15-100 cm away, Sporobolus cryptandrus 3 clumps 70-100 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #50) found on Bouteloua gracilis (B. gracilis common downslope, dead Bromus tectorum thick all over, Stipa comata [W] 4 clumps 50-80 cm away), Lookout Mtn., Jefferson Co. Colo., Oct. 3, 1987. Egg (lot #53) found on dead

stalk sticking up from Aristida purpurea (W) clump (A. purpurea 5 clumps 40-100 cm away, dead Bromus tectorum thick, Stipa comata common 20-100 cm away), Lookout Mtn., Jefferson Co. Colo., Oct. 3, 1987. Egg (lot #70) found on Bouteloua gracilis (B. gracilis common 5-100 cm away, Andropogon gerardii common 15-50 cm away, Stipa comata 4 clumps 60-100 cm away, Aristida purpurea clump 80 cm away, dead Bromus japonicus scattered 30 cm onward, dead Bromus tectorum scattered 35 cm away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #71) found on Bouteloua gracilis in B. gracilis sward (Andropogon gerardii common 40-80 cm away, dead Bromus tectorum scattered 20 cm onward, dead Bromus japonicus scattered 30 cm onward, Stipa comata 3 clumps 50-85 cm away, Aristida purpurea clump 85 cm away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #72) found on Bouteloua gracilis in B. gracilis sward (dead Bromus tectorum scattered 20 cm onward, dead Bromus japonicus scattered 20 cm onward, Stipa comata 2 clumps 80-100 cm away, Aristida purpurea clump 1 m away, Andropogon gerardii 3 clumps 80-100 cm away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #73) found on Bouteloua gracilis small clump below cliff (B. gracilis common 30-100 cm away, dead Bromus tectorum thick to one side of egg, Andropogon gerardii 4 clumps 60-100 cm away, Sporobolus cryptandrus common 80-100 cm away, Stipa comata clump 1 m away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #74) found on stem in big Bouteloua gracilis clump (B. gracilis thick 40-100 cm away, dead Bromus tectorum common 5-100 cm away, Stipa comata clump 1 m away, Sporobolus cryptandrus clump 1 m away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #76) found on Bouteloua gracilis (B. gracilis common 30-50 cm away, dead Bromus tectorum scattered 3 cm onward, Stipa comata common 20-60 cm away, Aristida purpurea clump 1 m away, Andropogon gerardii 80-100 cm away, dead Bromus japonicus 2 spots 35-80 cm away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. 2 eggs (lot #77) on Bouteloua gracilis in B. gracilis sward (B. gracilis common 0-80 cm away, Aristida purpurea clump 1 m away, Stipa comata frequent 35-80 cm away, Andropogon gerardii present 70-100 cm away, dead Bromus japonicus 2 clumps 25-80 cm away, dead Bromus tectorum scattered 10 cm onward), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #79) found on Bouteloua gracilis at big rock edge (B. gracilis common 0-70 cm away, dead Bromus tectorum common 5 cm onward, Stipa comata common 20-70 cm away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #84) found on dead Bromus tectorum inflorescence in thick B. tectorum sward in clearing among Cercocarpus and Populus angustifolia shrubs (B. tectorum live shoots common in sward, dead Bromus japonicus common 90-100 cm away, Agropyron [Leymus] ambiguus 90-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct 5, 1987. Egg (lot #86) found on dead Bromus tectorum inflorescence in thick B. tectorum sward (B. tectorum green sprouts common, Agropyron [Leymus] ambiguus common 30-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct 5, 1987. 3 eggs (lot #89) on Bouteloua gracilis in big sward of it (dead Bromus tectorum common 5 cm onward, Stipa comata 2 clumps 40 cm away, Sporobolus cryptandrus clump 90 cm away, Aristida purpurea 1.3 m away), E face Lookout Mtn., Jefferson Co. Colo., Oct 5, 1987. Egg (lot #90) found on Bouteloua gracilis (B. gracilis common 5-70 cm away, dead Bromus japonicus uncommon 20 cm onward, dead Bromus tectorum common 15 cm onward, Stipa comata 3 clumps 50-80 cm away, Sporobolus cryptandrus clump 1 m away), E face Lookout Mtn., Jefferson Co. Colo., Oct 5, 1987. Egg (lot #92) found on Bouteloua gracilis in B. gracilis sward (Stipa comata 5 clumps 30-50 cm away, dead Bromus tectorum common 5 cm onward), E face Lookout Mtn., Jefferson Co. Colo., Oct 6, 1987. Egg (lot #93) (Trichogrammatid wasp emerged Oct 27, 1987) found on dead Bromus tectorum stem in Bouteloua gracilis clump in B. gracilis sward (B. tectorum green sprouts very common 5 cm onward, Sporobolus cryptandrus 1.5 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct 6, 1987. Egg (lot #94) found on Bouteloua gracilis stem in giant B. gracilis sward (dead Bromus tectorum very thick 3 cm onward, Sporobolus cryptandrus 1 m away), E face Lookout Mtn., Jefferson Co. Colo., Oct 6, 1987. Egg (lot #96) (Trichogrammatid wasp emerged Oct 23, 1987) found on Bouteloua gracilis in big sward of it (dead Bromus tectorum thick 3 cm onward, Stipa comata 3 clumps 30-100 cm away, Aristida purpurea 3 clumps 30-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct 6, 1987. Egg (lot #97) found on Bouteloua gracilis in B. gracilis sward (dead Bromus tectorum thick 5 cm onward, Aristida purpurea common 15-50 cm away, Stipa comata 4 clumps 15-90 cm away, dead Bromus japonicus clump 70 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct 6, 1987. 3 eggs (lot #109) on dead Bromus tectorum inflorescences (one on spine from seed) 25 cm apart in thick B. tectorum sward in a hollow formed by a boulder outcrop on point of ridge and by a Cercocarpus bush (B. tectorum green sprouts 20 cm from first egg and right under other two eggs, Stipa comata clump 1 m away), Cherry Gulch, Jefferson Co. Colo., Oct 7, 1987. Egg (lot #110) found on dead Bromus tectorum

inflorescence stalk in thick B. tectorum sward in hollow among boulders and 3 Cercocarpus bushes on same ridge point as lot 109 (B. tectorum green shoots 30 cm away, Stipa comata 2 clumps 45-80 cm away), Cherry Gulch, Jefferson Co. Colo., Oct 7, 1987. Egg (lot #111) found on dead Bromus tectorum seed shell in thick B. tectorum sward between boulder and 3 Cercocarpus bushes on same ridge point as lot 109 (green B. tectorum shoots under egg, Stipa comata clump 70 cm away), Cherry Gulch, Jefferson Co. Colo., Oct 7, 1987. This ridge point (lots 109-111) was the only place to have a thick B. tectorum sward and was the only place to have Hesperia eggs despite searching elsewhere. Egg (lot #112) found on Bouteloua gracilis in large clearing (B. gracilis common 0-80 cm away, Stipa comata common 30-100 cm away, dead Bromus tectorum 2 clumps 60-70 cm away, Aristida purpurea clump 1.2 m away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. 4 eggs (lot #113) on tiny 3 cm Bouteloua gracilis clump in broad clearing edged by juniper and Cercocarpus (B. gracilis common 10-100 cm away, Stipa comata common 25-100 cm away, Bouteloua curtipendula clump 1 m away, Aristida purpurea clump 50 cm away, Agropyron [Pascopyrum] smithii 80-100 cm away, dead Bromus tectorum uncommon 30 cm onward), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #114) found on Bouteloua gracilis (B. gracilis 70-80 cm away, Stipa comata common 25-90 cm away, Agropyron [Pascopyrum] smithii common 25-100 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #115) found on Thlaspi arvense stem in Bouteloua gracilis clump in broad clearing (B. gracilis common 0-100 cm away, Stipa comata common 15-70 cm away, Aristida purpurea clump 50 cm away, dead Bromus japonicus clump 45 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #117) found on Bouteloua gracilis in broad clearing (B. gracilis common 0-90 cm away, Bouteloua curtipendula frequent 20-70 cm away, Stipa comata common 25 cm onward, Agropyron [Elymus, "Elytrigia"] albicans common 40-100 cm away, Andropogon gerardii clump 1 m away, dead Bromus tectorum scattered 40 cm onward), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #118) found on Bouteloua gracilis in broad clearing (B. gracilis common 0-100 cm away, Bouteloua curtipendula 2 clumps 20-80 cm away, Stipa comata common 20-80 cm away, dead Bromus tectorum scattered 10 cm onward), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Hatched egg (lot #119) found on Bouteloua gracilis in broad 4 m clearing (B. gracilis common 0-100 cm away, Stipa comata common 25-100 cm away, dead Bromus tectorum scattered 5 cm onward, Carex probably pensylvanica heliophila 2 clumps 90 cm away, Bouteloua curtipendula clump 1.2 m away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #122) found on Bouteloua gracilis in broad juniper-Cercocarpus clearing (B. gracilis common 0-80 cm away, Stipa comata common 35-100 cm away, dead Bromus tectorum scattered 20 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #123) found on Bouteloua gracilis in large B. gracilis sward 0-100 cm away (Cercocarpus and junipers 1-4 m away) (dead Bromus tectorum scattered 20 cm onward, Stipa comata common 30-100 cm away, Bouteloua curtipendula 2 clumps 1.2 m away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #124) found on Bouteloua gracilis in small Cercocarpus-juniper clearing (B. gracilis 0-50 cm away, Stipa comata common 15-100 cm away, Carex probably pensylvanica heliophila 90-100 cm away, Aristida purpurea clump 1 m away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #127) found on Bouteloua gracilis in open area (B. gracilis common 0-100 cm away, Stipa comata frequent 15-100 cm away, dead Bromus japonicus scattered 0 cm onward, dead Bromus tectorum uncommon 20 cm onward, Carex probably pensylvanica heliophila 1 m away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #128) found on Bouteloua gracilis in open area (B. gracilis common 0-100 cm away, Stipa comata 10-100 cm away, dead Bromus japonicus scattered 20 cm onward, dead Bromus tectorum uncommon 20 cm away, Carex probably pensylvanica heliophila 1 m away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #130) found on Bouteloua gracilis in open area (B. gracilis common 0-100 cm away, Stipa comata common 15 cm onward, dead Bromus tectorum rare 10-90 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #131) found on Bouteloua gracilis in open area (B. gracilis common 0-70 cm away, Stipa comata common 10-100 cm away, dead Bromus tectorum rare 50-90 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #132) found on Bouteloua gracilis in broad clearing (B. gracilis common 0-100 cm away, Stipa comata common 20 cm onward, dead Bromus tectorum rare 40-90 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #133) found on Bouteloua gracilis in broad clearing (B. gracilis common 0-60 cm away, Stipa comata common 50 cm onward, dead Bromus tectorum 40-100 cm away, Carex probably pensylvanica heliophila 3 clumps 60-100 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. 2 eggs (lot #134) found on Bouteloua gracilis in clearing (juniper 3 m away, 2 Cercocarpus 1 m away) (B. gracilis common 0-60 cm away, Carex probably pensylvanica heliophila 70-120 cm away, Stipa comata common 60-100 cm away, Muhlenbergia montana [W] 40-90 cm away, dead Bromus tectorum common 30 cm

onward), Red Rocks, Jefferson Co. Colo., Oct. 8, 1987. Egg (lot #138) found on Bouteloua gracilis (B. gracilis common 0-100 cm away, Carex probably pennsylvanica heliophila 20-80 cm away, dead Bromus tectorum scattered 15 cm onward), Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. Egg (lot #142) found on Bouteloua gracilis on open area below cliff (B. gracilis common 0-70 cm away, Stipa comata 2 clumps 50-55 cm away, dead Bromus tectorum 4 spots 15-70 cm away, Lycurus phleoides [W] 4 clumps 80-120 cm away [a rare grass]), Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. Egg (lot #143) found on Bouteloua gracilis clump with many inflorescences and other tall clutter (B. gracilis frequent 0-90 cm away, dead Bromus tectorum very common 5 cm onward, Sporobolus cryptandrus common 20-80 cm away, dead Bromus japonicus scattered 20 cm onward), Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. 3 eggs (lot #144) found on Bouteloua gracilis in nook of cliff boulder in Cercocarpus-juniper clearing (B. gracilis 0-40 cm away, dead Bromus tectorum common 5 cm onward, dead Bromus japonicus scattered 10 cm onward, Stipa comata 2 clumps 90-100 cm away), Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. Egg (lot #146) found on dead Bromus tectorum inflorescence (seed) in thick B. tectorum sward below 60 cm rock on sloping ridgetop (in broad clearing of boulder 1.5 m upslope and 4 Cercocarpus 3.5-4 m away) Bouteloua curtipendula 6 clumps 5-100 cm away, Andropogon gerardii common 45-100 cm away, Sporobolus cryptandrus 3 clumps 90-100 cm away, Stipa comata 3 clumps 50-80 cm away), Indian Gulch 1 mi. W Golden, Jefferson Co. Colo., Oct. 13, 1987. Oviposition 11:25 on dead Bromus tectorum inflorescence (on underside of horizontal peduncle at base of drooping spikelet pedicels) 10 cm above ground, among rocks in large B. tectorum sward on S-facing slope, several bushes and trees 2-3 m away, (B. tectorum 0-10 m, no green B. tectorum seedlings present, Sporobolus cryptandrus 20, 40, 50, 50, 90, 90, 1 m, Stipa comata 60, Bouteloua curtipendula 30, 40-90 common), Apex Gulch, Jefferson Co. Colo., Sept 3, 1988. Oviposition 13:47, she hovered for 1-2 minutes over grassland lacking dead grasses with little Bouteloua gracilis, landed on dormant Poa secunda var. sandbergii (sandbergii is a synonym of secunda in the latest Colo. flora, but is listed as a species in a Great Plains flora and a North American plant checklist, so I will call it a variety here) and laid egg (which later hatched) on horizontal dead leaf 2 cm above ground, and another egg found there (which failed to hatch) on vertical broader dead P. secunda var. sandbergii leaf ~2 cm above ground (P. secunda var. sandbergii 8, 8, 15, 15, 20, 20, 30, 50, 60-80 common, all dormant, Stipa comata 15, 20, common 30 cm onward, Sporobolus cryptandrus 15, Carex probably pennsylvanica heliophila 80, Aristida purpurea 10, 15, 40, 40, 45, 60, 60, Oryzopsis exiqua 20, 30); 1 egg (which failed to hatch) found on vertical green Aristida purpurea leaf and 2 eggs (which later hatched) found on horizontal dead Poa secunda var. sandbergii leaf (all 3 eggs in 7 cm wide clump of dormant P. secunda var. sandbergii, 12-15 cm from oviposition 13:47) (P. secunda var. sandbergii 0-10, 20, 50, 55-85, Stipa comata 15, 15, 15, etc. thick, Sporobolus cryptandrus 25, Oryzopsis exiqua 40, 45, Aristida purpurea 5-8, 60, 70); egg (which did not hatch) found on green Stipa comata leaf 12 cm above ground (8-15 cm from last 3 eggs and ~15 cm from oviposition 13:47) (S. comata 10, 20, 20, 20, 30 cm onward common, dormant Poa secunda var. sandbergii 8-15, 15, 45-75, Aristida purpurea 15, 20, 65, 70, Oryzopsis exiqua 40, 50, Sporobolus cryptandrus 20); egg (which later hatched) found (30 cm from previous Stipa comata egg, 40 cm from oviposition 13:47) on green Aristida purpurea leaf (A. purpurea 0-10, 30, 30, 30-50, 90 common, S. comata 8, 10, 15, 20, 20, 20, 30 etc. common, dormant Poa secunda var. sandbergii 30, 30-50, 40, etc., Oryzopsis exiqua 50, 60, Sporobolus cryptandrus 50); all on gentle N-facing grassland on sloping small ridgetop just SE Turkey Creek Can. entrance (S. Cooley gravel quarry), Jefferson Co. Colo., Sept. 16, 1988. Egg (which later hatched) found 8 cm above ground on dead Poa secunda var. sandbergii sheath (dormant P. secunda var. sandbergii plants with new 1-2 cm high green shoots 0-8, 5, 5, 8, 15, 20, 25, etc. onward thick, Aristida purpurea 8-12, Sporobolus cryptandrus 70, Stipa comata 3, 8, 10, 10-15, 15, 15, 19, 20, 20 cm onward thick, Bouteloua gracilis 25-3 m thick on one side of egg); egg (which did not hatch) found on dead Poa secunda var. sandbergii leaf 2 cm above ground (P. secunda var. sandbergii dormant plants with many new shoots 0-20, 10, 12, 15 etc. thick all over, Sporobolus cryptandrus 30, 35, 50, 60, Stipa comata 7-15, 8, 13, 20, 20, 25 etc. thick all over, Aristida purpurea 25, 65, 65, Poa compressa 8-15, 20); the previous two eggs were on gentle N-facing sloping small ridgetop grassland piece just SE of the eggs of Sept. 16, 1988; egg (which later hatched) found on dead vertical Poa secunda var. sandbergii blade 2 cm above ground (P. secunda var. sandbergii 0-1 m very thick, tiny green shoots 4, 4, 4 etc., Sporobolus cryptandrus 12, 20-25, Stipa comata 20, 25, 30, 35, 85, 90, Agropyron [Pascopyrum] smithii 10, 10, 15, 15, 20, 25, Aristida purpurea 10, 30, 85, 1 m, dead Bromus japonicus 15, Bouteloua gracilis 35-1 m); egg (which later

hatched) found (25 cm from last egg) on horizontal dead *Poa secunda* var. *sandbergii* leaf 4 cm above ground (*P. secunda* var. *sandbergii* 7, 10, 10, 10, 10, 15, 18, 20-1 m thick, no green shoots seen, *Stipa comata* 6, 17, 45, 50, 90, *Sporobolus cryptandrus* 15-22, 20, *Agropyron* [*Pascopyrum*] *smithii* 15, 17, 18, 18, 18, 20 cm etc. common, *Aristida purpurea* 35, 60, 70, *Bouteloua gracilis* 50-1 m, dead *Bromus japonicus* 25); egg (which did not hatch) found on horizontal dead *Poa secunda* var. *sandbergii* leaf 1.5 cm above ground (*P. secunda* var. *sandbergii* 0-1 m very thick, green 1 cm shoots 4, 7, 7, 7 etc., *Aristida purpurea* 3, 17-40, 28, 30, 30 onward common, *Stipa comata* 4, 60, *Agropyron* [*Pascopyrum*] *smithii* 12, 15, 20, 20, 20, etc. common, *Oryzopsis exiguua* 1 m, *Bouteloua gracilis* 50-55); egg (which later hatched) found (this and the last egg were 1 m from the previous two eggs) on dead *Agropyron* [*Pascopyrum*] *smithii* stem 5 cm above ground (dormant *Poa secunda* var. *sandbergii* 2-8, 10-15, 15, 15-30, 38 etc. very thick, new shoots 4, 5 etc., *A. smithii* 7, 7, 17, 20, 25, 25, 25 etc. common, *Aristida purpurea* 1, 3, 4, 20-25, 22-30, 25-30, 35, 70, *Sporobolus cryptandrus* 75, *Oryzopsis exiguua* 40-80, *Stipa comata* 17-25, 50, 65, 70); egg (which later hatched) found on vertical dead *Poa secunda* var. *sandbergii* leaf 2 cm above ground (dormant *P. secunda* var. *sandbergii* thick 0-2 m, new shoots 7, 8, 10 etc., *Aristida purpurea* 2, 15-35, 30-45, 35-40, 40-45, etc., *Stipa comata* 75, *Agropyron* [*Pascopyrum*] *smithii* 7, 7, 9, 15, 17, 17, 20 etc. common, *Poa agassizensis*? 90-1 m, *Bouteloua gracilis* 90, *Oryzopsis exiguua* 1 m); the last 5 eggs were all on a 4 m wide flat area in a small grassland on gentle N-facing slope below chaparral 1/3 km SSE of oviposition 13:47; the following eggs were 50 m to the E on N-facing rocky hillside among oak, *Rhus trilobata*, and *Cercocarpus* bushes at lower edge of chaparral; egg (which later hatched) found on dead *Bouteloua gracilis* leaf 2 cm above ground (*B. gracilis* 0-70, *Carex* probably *pennsylvanica heliophila* 10, 17, 17, 20, 25, 30, 35, etc., *Agropyron* [*Pascopyrum*] *smithii* 15, 18, 20-30, 30 etc., *Poa agassizensis* 35, 75, 80, *Poa arida* 30, 50, 50); 6 eggs (5 later hatched, 1 did not hatch) found (25 cm E of last egg) on *Bouteloua gracilis* leaves 3 cm above ground (*B. gracilis* 0-50, *Agropyron* [*Pascopyrum*] *smithii* 17, 20, 40, *Carex* probably *pennsylvanica heliophila* 20, 20-1 m, 30, 30, 40, 40, *Poa agassizensis* 50-1 m, 70-1 m, *Poa arida* with new shoots 10-15, 20-30, 30); all just SE Turkey Creek Can. entrance (S. Cooley gravel quarry), Jefferson Co. Colo., Sept. 20, 1988. Egg (det. by egg and hatched larva) found 14:08 on *Koeleria macrantha* (*K. macrantha* 15-30, 35, *Stipa comata* 20, common 30-100, *Carex* probably *pennsylvanica heliophila* 60-80, *Oryzopsis exiguua* 60-100, *Bouteloua gracilis* 65-100, *Sporobolus cryptandrus* 45-60), Red Rocks, Jefferson Co. Colo., June 25, 1989. Three ovipositions, she flew ~7 times and kept returning to bottom of small gulch where the shale was wet and gooey and covered with lush *Poa compressa* (commonest in bottom of gulch) and *Poa pratensis* (slightly later in growth, commoner on side of gulch): oviposition 12:35 on *P. compressa* (*P. compressa* 0-100 cm, *Poa pratensis* 50, *Agropyron* [*Pascopyrum*] *smithii* 50, *Mariscus*? 0-100); oviposition 12:36 on *P. compressa* (*P. compressa* 0-100, *P. pratensis* 60, *Eleocharis palustris* 5-100, *Carex xerantica* [brevior?] 50, *Scirpus americanus* ["*Schoenoplectus pungens*"] 50); oviposition 12:37 on probably *Agropyron* (*Pascopyrum*) *smithii* (leaves not boat-tipped as is *Poa*) (*P. pratensis* 10-100 cm and perhaps nearer, though some of these were perhaps *A. smithii*, *Juncus arcticus ater* 10-20, *E. palustris* 10-100); Horsetooth Res., Larimer Co. Colo. May 26, 1990. 2 eggs found on *Bouteloua curtipendula* dead dried narrow leaf tips ~5 cm above ground; S-facing slope, Lookout Mtn., Jefferson Co. Colo., Sept. 20, 1990. Late spring *juba* prefer to oviposit on various green grasses (*Poa compressa*, *pratensis*, *agassizensis*, *Koeleria*, perhaps *Agropyron smithii*--and in Calif. *Agrostis idahoensis*, *Deschampsia elongata*, *Stipa* nr. *nevadensis*), fall females oviposit on *Bouteloua gracilis*, dead *Bromus tectorum*, and dormant *Poa secunda* var. *sandbergii*, rarely on *Bouteloua curtipendula*, *Aristida purpurea*, and *Stipa comata* (in Calif. often on dead *Bromus rubens* seed heads). On *Bouteloua gracilis* most eggs are laid on short plants free of aerial clutter, on the lower edge of a clump where the clump hangs out over a slope and has better aerial access; on *P. s.* var. *sandbergii* oviposition is similar; but on *Bromus tectorum* eggs are laid on the dead inflorescence ~15 cm above ground. In 3.5 hours of searching for eggs at Red Rocks, Jefferson Co. Colo., Sept. 30, 1987, only the one egg was found, evidently because this was the only spot with a big *B. tectorum* sward. *B. tectorum* is a winter annual grass (like winter wheat); the seeds fall in May-July (rarely as late as Oct.), and sprout in late summer-fall (sprouting earlier in moister spots) so the sprouting leaves are 0-10 cm long in Oct., then they are dormant in winter and grow and mature in spring. *Bromus japonicus* is also an annual grass and also is dead in Sept.-Oct., but does not have green sprouts then, and no eggs were found on it. *Poa secunda* var. *sandbergii* (*Poa sandbergii* of some floras, but most recent floras treat *sandbergii* as a synonym of *secunda*,

a single variable species) is known from "mesas and foothills" in the Front Range but I found it only at one locality. It is a perennial, but is spring-flowering and withers and dries by summertime; the clumps in Sept. were straw-yellow and dormant (appearing dead) but close inspection revealed that a few small 1-cm-long green leaves were growing from the clump base (or would grow within a few weeks), so this grass behaves as a winter annual, the leaves emerging in mid Sept.-Oct., the plant maturing and setting seed by the next June, then turning straw-colored and appearing dead in July-early Sept. Clearly, Poa secunda var. sandbergii is a favorite oviposition site even though it appears dead. It would seem that females like to lay eggs on dead grass bunches (including dead Bromus tectorum inflorescences and "dead" Poa secunda var. sandbergii clumps) because the new shoots there are the most succulent grasses available in Sept.-Oct. for young larvae and these grasses are lush and green the next April-May as well. Most Sept.-Oct. grasses are dry or even brown, so, paradoxically, the female can provide the lushest food for her larvae by laying eggs on grasses that appear dead. Lab larvae eat Bromus tectorum new leaves as well as Poa pratensis. Only 7 hostplant records are available for the first (late May-June) generation of H. juba, when various green grasses (three Poa species, and probably Agropyron [Pascopyrum] smithii) were chosen, and Bouteloua gracilis is probably an occasional choice of females in the foothills (Bromus tectorum and Poa secunda var. sandbergii are senescent then); then the Sept. generation prefers Bouteloua gracilis (because most other grasses are dried up then) and the effectively winter annuals Bromus tectorum and Poa secunda var. sandbergii. H. juba oviposits on or near ridgetops much more often than on slopes or flats. Shapiro (1981b) claimed that juba overwinters as adults, and that adult overwinterers were the adults caught in June. My research obviously proves that juba overwinters as young larvae (probably about 2nd stage usually, probably 1st and 3rd stage sometimes). H. juba and H. leonardus pawnee eggs always hatch in the lab (whereas H. comma eggs hibernate, though some hatch after a month or two in the lab), and juba larvae grow very fast (the fastest Hesperia) and pupate as early as late Nov.-early Dec. in the lab for an oviposition to adult time of as little as two months, versus three months or more in most Hesperia (Scott 1975c). Thus juba larvae have plenty of time to mature in fall and spring to produce adults in mid May-June. Additional strong proof that juba adults do not hibernate is that adults are not found in March-mid May in Colorado, when true overwintering adult butterflies are common. Thus there are two yearly flights in Colo. Early stages: EGG white, no color change, no basal flange or a very weak one. FIRST-STAGE LARVA yellowish-cream, becoming creamy-tan or greenish-tan, neck and T1 brown with black collar edged anteriorly by white, anterior seta on A10 short (slightly shorter than H. comma); head black. All Hesperia first-stage larvae have four setae in the following pattern on the prothoracic shield: three anterior setae (D1, XD1, and XD2) and one smaller posterior seta (D2) behind XD1 (thus the drawings of C. D. MacNeill [1964] for H. comma etc. need some improvement). MATURE LARVA dark-brown with a slight greenish tinge, four transverse brownish-green ridges on rear of each segment, middorsal 1-mm-wide dark-brown line on abdomen (this a 1-mm-wide green band on one larva), prothoracic shield black, narrowly-edged anteriorly with white, tiny white curves near T1 spiracle, spiracles black; head black, a cream stripe along coronal sulcus. PUPA dark-brown, abdomen ochre with rear of each segment chitin-brown, a middorsal brown line on A2-7 and a weak one on T2-A1, abdomen covered with transverse brown dashes, between A6 & A7 are 2 ventral black patches, a brown dot is ventroposterad of each abdomen spiracle, eye has tan mottling, two tan patches are on top of head, top of thorax mottled tan (with two long brown streaks on T1 and a long anteriorly-convex bowl-shaped brown curve on top of T2 and another on T3), proboscis extends 0.5-1 mm beyond wings; one pupa was dark-green (abdomen greenish-ochre) when young, turning almost-unspotted tan (wings pale-brown); cremaster fairly long with straight lateral margins and hooked crochets. The cremaster varies in shape in Hesperia: H. uncas has a long cremaster also but it has long unhooked crochets; H. ottoe and H. viridis have a short narrow-tipped cremaster (with convex lateral margins), and H. comma assiniboia, H. comma colorado, H. pahaska, H. leonardus montana, and H. leonardus pawnee also have a narrow cremaster with hooked crochets (which is evidently short also, Scott 1975c); MacNeill (1964) stated that H. columbia and H. lindseyi have a long cremaster with hooked crochets.

Hesperia comma oроplata Scott. Oviposition 11:19 Bouteloua (Chondrosom) gracilis leaf underside (B. gracilis 0-100, Agropyron [Elymus=Sitanion] ?longifolius 20, 25); 2 eggs found on Bouteloua gracilis (B. gracilis 0-100, Stipa comata both ~10, ~40 cm); Bear Creek, Chaffee Co. Colo., Sept. 5, 1990. Carex occurs at this site only on N-facing slopes, where H. comma also flies.

Hesperia comma assiniboia (Lyman) (=ochracea Lindsey). One egg found on

Andropogon (Schizachyrium) scoparius (previously misidentified as A. saccharoides [B]), 1 mi. N Cheesman Res., Sept. 3, 1971. 8 eggs found on Carex sp. (B), 3 eggs found on Andropogon (Schizachyrium) scoparius (previously misidentified as A. saccharoides [B]), 3 eggs found on Arenaria fendleri Gray (G) leaves, all eggs with the characteristic basal flange of comma, and one oviposition on Bouteloua (Chondrosium) gracilis (B), all 1 mi. N Cheesman Res., Jefferson Co. Colo., Sept. 7, 1971. Oviposition 11:46 B. gracilis (B), Nighthawk, Douglas Co. Colo., Sept. 1, 1970. Oviposition 12:01 on dead Bromus (Anisantha) tectorum inflorescence stalk under Berberis repens (a few B. tectorum green shoots were there, Andropogon gerardii clump 20 cm away, Agropyron [Pascopyrum] smithii 20 & 30 cm away, Andropogon (Schizachyrium) scoparius 1 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 23, 1987. Oviposition 12:30 on underside of Stipa comata leaf (Bouteloua gracilis 25 cm away, Poa sp. 25 cm away, Andropogon gerardii 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 23, 1987. Oviposition 10:58 on underside of Poa pratensis (W) leaf, Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 1 egg (lot #2) found on dead Bromus tectorum inflorescences near 20-cm-wide rock in B. tectorum sward in small clearing downslope from Cercocarpus bush (Stipa comata 5 clumps 10-40 cm away, Sporobolus cryptandrus 5 clumps 70 cm away, Bouteloua gracilis 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 1 egg (lot #3) found on Bouteloua curtipendula leaf beside 20 cm rock in Bromus tectorum sward downslope from Cercocarpus bush (B. curtipendula 6 small clumps were at rock edge and 15-40 cm away, Stipa comata 4 clumps 10-25 cm away, Sporobolus cryptandrus 70 cm & 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 1 egg (lot #4) found on dead Bromus tectorum inflorescence above a 25-cm rock on B. tectorum sward downslope from Cercocarpus shrub (Agropyron [Pascopyrum] smithii [W] 30 cm away, Bouteloua gracilis 35 & 50 cm away, Stipa comata 40 & 40 cm away, Sporobolus cryptandrus 1 m away), Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 5 eggs (lot #9) found 1-2 cm above ground on side of Carex pensylvanica heliophila (W) leaves, at lower edge of large boulder, Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. 2 eggs (lot #10) found on underside of Bouteloua gracilis leaves, in a sward of B. gracilis and a little dead Bromus tectorum (Sporobolus cryptandrus two patches 30 cm away, Stipa comata [W] one clump 25 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #11) found on underside of dead Bromus tectorum inflorescence in B. tectorum sward above a 30 X 20 cm rock, 80 cm downslope from Cercocarpus bush (Stipa comata 5 clumps 0-30 cm away, Sporobolus cryptandrus clump 45 cm away, Bouteloua curtipendula 50 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #13a) found on underside of Andropogon (Schizachyrium) scoparius leaf in 30 X 20 cm clump of it (A. [S.] scoparius 2 other clumps 15-30 cm away, Stipa comata 2 clumps 25-30 cm away, Sporobolus cryptandrus 2 clumps 30 & 60 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #13b) found on underside of Andropogon (Schizachyrium) scoparius leaf (A. [S.] scoparius 2 other clumps 25 cm away, Stipa comata clump 15 cm away, Sporobolus cryptandrus 2 clumps 40 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #18) found on dead Bromus tectorum inflorescence stalk next to 15 cm rock in B. tectorum sward in Cercocarpus clearing (Stipa comata common 5-40 cm away, Sporobolus cryptandrus common 15-70 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #19) found on dead Bromus tectorum inflorescence stalk beside 35 cm rock in B. tectorum sward, in Cercocarpus clearing (Sporobolus cryptandrus common 50-80 cm away, Stipa comata 4 clumps 25-50 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #20) on dead Bromus tectorum inflorescence stalk sticking out of a small Stipa comata clump beside 50 cm rock in B. tectorum sward in clearing among Cercocarpus (S. comata several 10-90 cm away, Andropogon gerardii common 30-70 cm away, Bouteloua gracilis clump 40 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Old egg (lot #22) with Trichogrammatid wasp exit hole found on dead Bromus tectorum inflorescence above 1 m wide rock pile in B. tectorum sward, 60 cm from Cercocarpus bush (Sporobolus cryptandrus common 20-100 cm away, Stipa comata 40-100 cm away), Van Bibber Creek, Jefferson Co. Colo., Sept. 25, 1987. Egg (lot #54) found on Carex probably pensylvanica heliophila (C. p. heliophila thick, Stipa comata common 30-100 cm away, dead Bromus japonicus common scattered 5 cm onward, dead Bromus tectorum 2 plants 40-50 cm away, Bouteloua curtipendula clump 30 cm away, Bouteloua gracilis clump 80 cm away), Lookout Mtn., Jefferson Co. Colo., Oct. 3, 1987. Egg (lot #55) found on Carex probably pensylvanica heliophila (C. p. heliophila common all over, Stipa comata common 10-90 cm away, Bouteloua curtipendula 2 clumps 20-40 cm away, dead Bromus japonicus common all over, Bouteloua gracilis clump 40 cm away), Lookout Mtn., Jefferson Co. Colo., Oct. 3, 1987. Egg (lot #56) found on dead inflorescence in Stipa comata (W) clump (S.

comata common 5-100 cm away, Carex probably pennsylvanica heliophila common 5-100 cm away, Andropogon gerardii 5 clumps 50-70 cm away, Sporobolus cryptandrus 3 clumps 60-70 cm away), Lookout Mtn., Jefferson Co. Colo., Oct. 3, 1987. Egg (lot #75) found on Bouteloua gracilis in B. gracilis sward (dead Bromus tectorum common 5 cm onward, Aristida purpurea clump 80 cm away, dead Bromus japonicus clump 30 cm away, Bouteloua curtipendula 4 clumps 60-90 cm away, Stipa comata common 50-100 cm away), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #80a) found on Carex probably pennsylvanica heliophila in sward of it (Stipa comata clump 70 cm away, Agropyron [Leymus] ambiguus 5 clumps 50-100 cm away, dead Bromus japonicus scattered 5 cm onward, dead Bromus tectorum clump 60 cm away, E face Lookout Mtn., Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #80b) found on Carex probably pennsylvanica heliophila at edge of sward of it (dead Bromus japonicus scattered 10 cm onward, Stipa comata 3 clumps 25-55 cm away, Agropyron [Leymus] ambiguus 1 m away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #81) found on Carex probably pennsylvanica heliophila on edge of sward of it (dead Bromus tectorum common 5 cm onward, dead Bromus japonicus common 0 cm onward, Sporobolus cryptandrus 2 clumps 50-90 cm away, Agropyron [Leymus] ambiguus common 35-80 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #82) found on Carex probably pennsylvanica heliophila on edge of sward of it (Agropyron [Leymus] ambiguus common 30-100 cm away, dead Bromus japonicus common 15 cm onward, dead Bromus tectorum scattered 25 cm onward), E face Lookout Mtn., Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #83) found on Carex probably pennsylvanica heliophila (C. probably p. heliophila 3 clumps 10-20 cm away, dead Bromus japonicus common 5 cm onward, dead Bromus tectorum clump 1 m away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #85) found on Carex probably pennsylvanica heliophila (dead Bromus tectorum thick 5 cm onward, dead Bromus japonicus common 15 cm onward, Agropyron [Leymus] ambiguus common 50-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #87) found on Bouteloua gracilis in big sward of it (dead Bromus tectorum thick 0 cm onward, Stipa comata 3 clumps 90-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #95) found on Bouteloua gracilis in big B. gracilis sward (dead Bromus tectorum thick, Stipa comata common 30-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #98) found on dead Bromus tectorum inflorescence above a 30 cm wide rock in a very thick B. tectorum sward in a 2 m wide Cercocarpus clearing (B. tectorum green shoots all over, Bouteloua gracilis common 5 cm onward, Stipa comata clump 30 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. 2 eggs (lot #99) on Carex probably pennsylvanica heliophila (C. probably p. heliophila common 10-45 cm away, Stipa comata common 20-100 cm away, Agropyron [Leymus] ambiguus clump 1 m away, dead Bromus japonicus common 5 cm onward), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #100) found on Carex probably pennsylvanica heliophila (C. probably p. heliophila common 20-40 cm away, dead Bromus japonicus scattered 10 cm onward, Agropyron [Leymus] ambiguus common 3-100 cm away, Andropogon gerardii few 90-100 cm away, Sporobolus cryptandrus clump 60 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #101) found on Bouteloua gracilis in 40 cm clump of it (Sporobolus cryptandrus 3 clumps 35-70 cm away, Stipa comata 4 clumps 50-100 cm away, dead Bromus japonicus scattered 3 cm onward, dead Bromus tectorum uncommon 15 cm onward), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #102) found on Bouteloua gracilis in big sward of it (dead Bromus tectorum thick 5 cm onward, Stipa comata 2 clumps 50-100 cm away, dead Bromus japonicus rare 30-50 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. 2 eggs (lot #103) on Carex probably pennsylvanica heliophila (C. probably p. heliophila common 30-100 cm away, dead Bromus tectorum common 20 cm onward, dead Bromus japonicus very common 20 cm onward, Agropyron [Leymus] ambiguus clump 1 m away, Stipa comata clump 1 m away, Bouteloua curtipendula 40-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #104) found on Bouteloua gracilis in 35 cm clump of it (B. gracilis common 0-100 cm away, dead Bromus japonicus common 10 cm onward, dead Bromus tectorum uncommon 15 cm onward, Bouteloua curtipendula clump 80 cm away, Agropyron [Leymus] ambiguus 2 clumps 50-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #105) found on Bouteloua curtipendula at lower edge of 1 m B. curtipendula sward (dead Bromus japonicus common 10 cm onward, Bouteloua gracilis 50-80 cm away, dead Bromus tectorum uncommon 40 cm onward), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #106) found on Carex probably pennsylvanica heliophila (C. probably p. heliophila common 0-100 cm away, dead Bromus japonicus common 5 cm onward, Bouteloua curtipendula common 20-100 cm away, Sporobolus cryptandrus clump 1.2 m away), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #107) found on single tiny stem of Stipa comata 1 mm from Bouteloua curtipendula in B.

curtipendula sward (B. curtipendula rather than S. comata must be considered the host here) (S. comata 3 other clumps 35-45 cm away, Koeleria macrantha [W] 2 clumps 25-30 cm away, dead Bromus japonicus common 5 cm onward), E face Lookout Mtn., Jefferson Co. Colo., Oct. 6, 1987. Egg (lot #116) found on Carex probably pennsylvanica heliophila (C. probably p. heliophila 0-25 cm away, Bouteloua gracilis common 15-60 cm away, Stipa comata 2 clumps 30-80 cm away, Agropyron [Pascopyrum] smithii frequent 25-100 cm away, dead Bromus tectorum scattered 20 cm onward), Red Rocks, Jefferson Co. Colo., Oct. 8, 1987. Egg (lot #125) found on Carex probably pennsylvanica heliophila (C. probably p. heliophila common 0-100 cm away, Stipa comata 3 clumps 50-100 cm away, dead Bromus tectorum common 10 cm onward, Bouteloua gracilis several 70-100 cm away), Red Rocks, Jefferson Co. Colo., Oct. 8, 1987. Egg (lot #126) found on Carex probably pennsylvanica heliophila under edge of juniper canopy (C. probably p. heliophila common 5-100 cm away, Stipa comata 2 clumps 90-100 cm away, dead Bromus tectorum scattered 10 cm onward under juniper, Aristida purpurea 1.2 m away), Red Rocks, Jefferson Co. Colo., Oct. 8, 1987. Egg (lot #135) found on Bouteloua gracilis in 3 m wide "clearing" (B. gracilis common 0-50 cm away, dead Bromus tectorum common 15 cm onward, Stipa comata common 25-100 cm away, dead Bromus japonicus 80 cm away, Carex probably pennsylvanica heliophila 1.2 m away), Red Rocks, Jefferson Co. Colo., Oct. 8, 1987. Egg (lot #136) with 2 Trichogrammatid exit holes found on Carex probably pennsylvanica heliophila (C. probably p. heliophila common 0-100 cm away, 1/2 m tall grass probably Agropyron [Leymus] ambiguus 1 m away, Koeleria macrantha [W] 4 clumps 20-80 cm away, Stipa comata common 20-100 cm away, dead Bromus japonicus scattered 10 cm onward, Agropyron [Pascopyrum] smithii 4 clumps 90-100 cm away, Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. Egg (lot #137) found on Bouteloua gracilis in broad 6 m "clearing" (B. gracilis common 0-100 cm away, dead Bromus tectorum frequent 15-80 cm away, Carex probably pennsylvanica heliophila common 50-100 cm away), Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. Egg (lot #139) found on Carex probably pennsylvanica heliophila (C. probably p. heliophila 5 clumps 5-100 cm away, Andropogon gerardii thick 25-100 cm away, dead Bromus tectorum scattered 4 cm onward, dead Bromus japonicus uncommon 10 cm onward, Stipa comata clump 50 cm away, Bouteloua gracilis thick 30-100 cm away), Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. 3 eggs (the third 3 cm from the other two) (lot #141) found on Carex probably pennsylvanica heliophila (C. probably p. heliophila common 0-80 cm away, dead Bromus tectorum common 80-100 cm away [30-100 cm from 3rd egg]), Red Rocks, Jefferson Co. Colo., Oct. 9, 1987. 1 egg found on Carex probably pennsylvanica heliophila, 2 eggs found on Bouteloua gracilis; Lookout Mtn., Jefferson Co. Colo., Sept. 20, 1990. Larva 2 cm long found in silked-dirt tunnel 3 cm long in soil among Bouteloua curtipendula roots, leaves chewed off around tunnel and frass among stumps, larva was killed during removal from nest, but must have been H. comma or juba because of its large size (H. viridis or pahaska or uncas larvae are much smaller at this time) and the head color pattern matches the pattern of 3rd-stage comma rather than juba; S-facing slope, Apex Gulch, Jefferson Co. Colo., Aug. 24, 1990. Egg found on Carex probably pennsylvanica heliophila; NE Foxton, Jefferson Co. Colo., Aug. 25, 1990. Egg found on Bouteloua curtipendula leaf top; Mt. Vernon Historic Site, Jefferson Co. Colo., Sept. 3, 1990. Egg found on Carex pennsylvanica heliophila (many inflorescences found); Indian Creek Cgd., Douglas Co. Colo., Sept. 18, 1990. HOSTPLANTS: Females prefer to oviposit on Carex probably pennsylvanica heliophila, and also oviposit on Bouteloua gracilis and dead B. tectorum, rarely on other grasses. Larvae will eat many grasses in the lab (Scott 1975c reared seven Hesperia on Poa pratensis and Digitaria sanguinalis). Eggs are usually laid ~2-3 cm above ground. Eggs hibernate; in fact, all of the foothills (5400-6500') eggs hibernate even in the lab, whereas eggs of the high altitude (10,300') H. c. colorado hatch fairly frequently in the lab (though in the cold temperatures of nature surely none hatch before spring). EGGS of H. comma have a distinct basal flange (no flange or a very slight one in H. juba, no flange in H. leonardus pawnee), stay whitish in color (pawnee eggs turn pinkish, juba eggs stay whitish), and are smaller than pawnee eggs (juba are also small). FIRST-STAGE LARVAE have the anterior (D1) seta on A10 short (but slightly longer than H. juba; seta very long in pawnee).

Hesperia comma assiniboia-colorado. Egg (lot #145) found on Carex brevipes (S; identification based on plants with inflorescences collected at egg site June 26, 1988), hilltop SSE Empire, 9400', Clear Creek Co. Colo., Oct 12, 1987.

Hesperia comma colorado (Scudder). 1 egg (typical comma egg, white with basal flange) found on litter (Carex foenea common 1 cm-2 m away, Agropyron [Elymus] trachycaulus andinus 2, 4, 10, 10, 10, 15, 18, 20, 20, 20, etc. common to 1 m, Poa fendleriana [=longiligula] big clumps 15, 40, 90, 1 m, Poa nemoralis interior 20, 40, 40, 45, 50, Carex rupestris drummondiana 90, 90, Carex

oreocharis 80-110), the egg diapause. Tennessee Pass, 12000', Park Co. Colo., Aug. 31, 1988. Carex foenea is probably the main host at this locality as it is the commonest suitable sedge. Eggs hibernate. Carex foenea and C. brevipes both resemble the main host of foothills H. comma assiniboia (Carex pennsylvanica heliophila) in appearance (about 10 cm tall with narrow green leaves) and all three grow on slopes etc. In lab, some eggs (by females from Tennessee Pass, Lake Co. Colo.) hibernated, while others hatched and the larvae fed to pupation on Poa pratensis.

H. ottoe Edw. Oviposition 10:12 on side of leaf, oviposition 12:00 on side (top) of leaf, both on Andropogon gerardii Red Rocks, Jefferson Co. Colo., July 11, 1984. 2 eggs (cream like eggs laid by identified females, and first-stage larvae have D1 setae long on A9 as in ottoe) found on leaves of A. gerardii, Red Rocks, July 12, 1984. Oviposition 8:25 on underside of A. gerardii leaf, preoviposition 9:35 on underside of A. gerardii leaf, (another ovip. on A. gerardii seen by William McGuire), Red Rocks, July 4, 1985. Oviposition 9:22 on underside of A. gerardii leaf, Red Rocks, July 2, 1986. 6 eggs (3 produced 1st stage larvae with long D1 on A9 characteristic of ottoe, 3 did not hatch) found on A. gerardii in 1-2 m wide cluster of A. gerardii (Stipa comata common near cluster, Carex probably pennsylvanica heliophila on one side of cluster), Mt. Zion, Jefferson Co. Colo., July 11, 1988. Egg (#110, probably ottoe but did not hatch) found on A. gerardii (A. gerardii 0-1 m, Agropyrum [Pascopyrum] smithii 20, 20, 40, 90, Oryzopsis exiguua 70, 70, 90, Carex probably pennsylvanica heliophila 25, 30, 40, onward, Stipa comata 90, 1 m), Red Rocks, Jefferson Co. Colo., July 4, 1988. 1 larva 11 mm long found in A. gerardii leaf nest (reared, pupated Oct. 20, male emerged Nov. 10); Mt. Vernon Historic Site, Jefferson Co. Colo., Sept. 3, 1990. Half-grown larva (probably ottoe, larva similar to ottoe with head black with cream adfrontal & coronal stripes, pupa similar to ottoe, pupated Oct. 25, pupa died) found on A. gerardii; Horsetooth Res., Larimer Co. Colo., Sept. 14-15, 1990. Larva 8 mm long with chestnut head and cream coronal & adfrontal stripes found in Bouteloua curtipendula aerial leaf nest (reared, pupated Oct. 6, male emerged Oct. 25); S-facing slope, Apex Gulch, Jefferson Co. Colo., Aug. 27, 1990. HOSTPLANTS AND NEST: Andropogon gerardii is a popular hostplant in Colo. (although William McGuire observed oviposition on Bouteloua [Chondrosium] gracilis, and at another site A. gerardii is rare and the only oviposition was seen by McGuire on Carex peyeri). Interestingly, H. ottoe larvae have aerial nests (females oviposit and larvae occur far above ground); all other Colo. Hesperia have soil nests, based on larvae discovered in nature and on their short hosts (on which aerial nests do not occur). H. ottoe, Polites origenes rhena, and Atrytone arogos all prefer A. gerardii, and all are basically Great Plains taxa which carried this preference westward with them to the Colo. foothills (they also make aerial nests, and P. origenes is the only aerial Polites). Half-grown larvae hibernate. HALF-GROWN LARVA tan; head chestnut-brown. MATURE LARVA medium gray-brown, A2-9 with a slight reddish tinge, heart-band darker, collar wide, black; head black with cream stripe beside coronal sulcus, and cream stripe laterally edging adfrontal sulcus. PUPA pale brown on head & thorax (thorax & most of wings olive-green on day of pupation), wings tan, orbit brown, one pupa has abdomen pale pink (esp. dorsally) on day of pupation, turning pinkish-tan (pinkish on front of each segment, pale brown on rear 1/3), intersegmental areas A4-7 orange-brown, another pupa merely tan on abdomen, T1 spiracle pink-tan, black specks are heavy on one pupa, light on another (black specks on T2-3, black splotchy areas on head, black dots on dorsal wing margin), 3 rows of black transverse dashes on A2-7 (very faint on A1), A4-6 each has a supraventral hairy mound, cremaster & proboscis tip red-brown, cremaster fairly short (lateral margins convex), proboscis barely extends beyond wings & A4, eye then antenna club turns red before hatching. Pupa lasts 19-21 days in lab (2 males).

H. leonardus montana (Skin.). Ovipositions 9:30, 10:30 on underside of leaves of Bouteloua (Chondrosium) gracilis, Lone Rock Cgd., Jefferson Co. Colo., Sept. 2, 1979. Oviposition 11:33 on underside of leaf of B. gracilis, Lone Rock Cgd., Jefferson Co. Colo., Aug. 27, 1986. Preovipositing female landed on B. gracilis after ignoring Bouteloua curtipendula but did not lay; NE Foxton, Jefferson Co. Colo., Aug. 25, 1990. Four other persons have also observed ovipositions on B. gracilis, so it must be the main hostplant. Young larvae must hibernate (probably stage 1 usually, sometimes stage 2).

H. leonardus pawnee Dodge. Oviposition 12:11 on dead leaf tip of Carex probably pennsylvanica heliophila in 2 m-wide patch of this sedge, while female was resting on Thlaspi arvense plant (one shoot of Stipa viridula Trin. (W) was 5 cm from egg), Green Mtn., Jefferson Co. Colo., Sept. 5, 1985. Oviposition 12:01 on underside of Sporobolus cryptandrus (W), Green Mtn., Sept. 12, 1985. Oviposition 12:01 on underside of Aster ericoides leaf (only Carex probably

pensylvanica heliophila was all around egg, Stipa viridula [W] was 10 cm and 15 cm from egg, a Bouteloua [Chondrosium] gracilis plant was 25 cm from egg); oviposition 13:25 on underside of B. gracilis leaf (the nearest other monocot was Stipa sp. 25 cm away); oviposition 13:37 on underside of B. gracilis leaf (the nearest other monocot was a small Stipa comata (W) 30 cm away); oviposition 15:41 on bract of dead Bromus (Anisantha) tectorum (nearby live monocots were B. gracilis beneath and common all around egg, a small Agropyrum [Pascopyrum] smithii var. molle (W) 10 cm from egg, a big Sporobolus cryptandrus (W) clump 20 cm from egg); Green Mtn., Jefferson Co. Colo., Sept. 14, 1985. Oviposition 10:51 on underside of fruit of dead Thlaspi arvense plant among many B. gracilis (the only other nearby monocots were two small Stipa viridula (W) clumps both 20 cm away), Green Mtn., Jefferson Co. Colo., Sept. 19, 1985. Oviposition 12:47 on 3-cm-wide Bouteloua gracilis clump (some dead Bromus japonicus 2 cm away, Agropyrum [Pascopyrum] smithii var. molle [W] common 10 cm away, Bouteloua curtipendula less common 15 cm away), W Soda Lakes SE Morrison, Jefferson Co. Colo., Sept. 10, 1987. Oviposition 11:30 on underside of Bouteloua gracilis leaf (dead Bromus japonicus plants scattered nearby, a Agropyrum [Pascopyrum] smithii clump 25 cm away), Red Rocks, Jefferson Co. Colo., Sept. 21, 1987. Egg (lot #7) found on side (top) of Bouteloua gracilis leaf in middle of 30 X 25 cm B. gracilis patch (dead Bromus tectorum scattered about, Sporobolus cryptandrus frequent 30 cm away, Stipa comata 3 clumps 40-70 cm away, Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. Egg (lot #32) with Trichogrammatid exit hole found on Bouteloua gracilis (B. gracilis 3 clumps 5-20 cm away, Stipa comata 4 clumps 30-70 cm away, dead Bromus japonicus scattered all over 5 cm onward, Bouteloua curtipendula 2 clumps 70-100 cm away, Agropyron [Elymus="Sitanion"] elymoides ["Sitanion hystrix"] 3 clumps 60-80 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #33) with Trichogrammatid exit hole found on Bouteloua curtipendula tiny clump (B. curtipendula all over 5-100 cm away in tiny clumps, Aristida purpurea Nutt. [W] 2 clumps 25-100 cm away, dead Bromus japonicus scattered all over 5 cm onward), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #34) found on Bouteloua curtipendula at edge of 20 X 30 cm clump of it (B. curtipendula 80 cm away, dead Bromus japonicus dead scattered all over 5 cm onward, Stipa comata common 20-90 cm away, Aristida purpurea clump 90 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #35) found on Bouteloua gracilis (B. gracilis all over, Stipa comata 5 clumps 40-100 cm away, dead Bromus japonicus uncommon scattered 5 cm onward, dead Bromus tectorum common all over 5 cm onward), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #41) found on Bouteloua gracilis (B. gracilis thick, dead Bromus tectorum common 5 cm onward, dead Bromus japonicus scattered 50 cm onward, Sporobolus cryptandrus clump 70 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #42) found on Bouteloua gracilis (B. gracilis thick, dead Bromus japonicus scattered, dead Bromus tectorum common 20 cm onward, Stipa comata common 15-100 cm away, Sporobolus cryptandrus 3 clumps 70-100 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. 2 eggs (lot #43) found on Bouteloua gracilis in B. gracilis sward (dead Bromus japonicus common, dead Bromus tectorum common 5 cm onward, Stipa comata common 30-100 cm away, Sporobolus cryptandrus 3 clumps 30-60 cm away), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #44) found on Bouteloua gracilis (B. gracilis common, Stipa comata common 15 cm onward, dead Bromus tectorum common 40 cm onward, dead Bromus japonicus common 40 cm onward), Falcon County Park, Jefferson Co. Colo., Oct. 2, 1987. Egg (lot #51) found on Bouteloua gracilis (B. gracilis thick nearby, dead Bromus tectorum fairly common nearby, Stipa comata 1 tiny clump 5 cm away, Sporobolus heterolepis? 2 clumps 30-40 cm away), Lookout Mtn., Jefferson Co. Colo., Oct. 3, 1987. Egg (lot #52) found on Bouteloua gracilis (B. gracilis thick, dead Bromus tectorum fairly common, Aristida purpurea [W] clump 30 cm away, Stipa comata 2 clumps 35-50 cm away), Lookout Mtn., Jefferson Co. Colo., Oct. 3, 1987. 3 eggs (one hatched)(lot #78) found on Bouteloua gracilis in B. gracilis sward (dead Bromus tectorum common 5 cm onward, Stipa comata common 30 cm onward), Chimney Gulch, Jefferson Co. Colo., Oct. 5, 1987. Egg (lot #88) found on Bouteloua gracilis in big sward of it (Stipa comata 4 clumps 40-100 cm away, dead Bromus tectorum thick 5 cm onward), E face Lookout Mtn., Jefferson Co. Colo., Oct 5, 1987. Egg (lot #91) found on Bouteloua gracilis in big sward of it (dead Bromus japonicus uncommon 5 cm onward, dead Bromus tectorum common 10 cm onward, Stipa comata 4 clumps 30-100 cm away), E face Lookout Mtn., Jefferson Co. Colo., Oct 6, 1987. Egg (lot #108) found on Bouteloua gracilis (B. gracilis common 0-40 cm away, Stipa comata common 15 cm onward, Aristida purpurea common 20-100 cm away, dead Bromus japonicus scattered), Cherry Gulch, Jefferson Co. Colo., Oct 7, 1987. Egg (lot #120) found on Bouteloua gracilis in broad clearing (B. gracilis common 0-30 cm

away, Stipa comata common 30 cm onward, Carex probably pennsylvanica heliophila 129 clump 70 cm away, dead Bromus tectorum frequent 5 cm onward, dead Bromus japonicus 60 cm away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #121) found on Bouteloua gracilis (B. gracilis 0-50 cm away, Stipa comata common 50-100 cm away, Carex probably pennsylvanica heliophila 50-90 cm away, dead Bromus tectorum frequent 10 cm onward), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Hatched egg (lot #129) found on Bouteloua gracilis in open area (B. gracilis common 0-100 cm away, Carex probably pennsylvanica heliophila 4 clumps 30-100 cm away, Stipa comata 4 clumps 20-50 cm away, Aristida purpurea clump 1 m away), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #134) found on Bouteloua gracilis in clearing (juniper 3 m away, 2 Cercocarpus 1 m away) (B. gracilis common 0-60 cm away, Carex probably pennsylvanica heliophila 70-120 cm away, Stipa comata common 60-100 cm away, Muhlenbergia montana [W] 40-90 cm away, dead Bromus tectorum common 30 cm onward), Red Rocks, Jefferson Co. Colo., Oct 8, 1987. Egg (lot #140) found on Bouteloua gracilis in open area (B. gracilis thick sward 0-100 cm away, Stipa comata common 20-100 cm away, Andropogon gerardii 70-100 cm away, dead Bromus tectorum 1 spot 70 cm away, dead Bromus japonicus common 10 cm onward), Red Rocks, Jefferson Co. Colo., Oct 9, 1987. 1 egg found Bouteloua curtipendula leaf top, 1 egg found Bouteloua gracilis, 2 eggs found beside each other on Bromus tectorum seed 10 cm above B. gracilis clump (B. gracilis 0-100, B. tectorum common every 5 cm or so); S-facing slope, Lookout Mtn., Jefferson Co. Colo., Sept. 20, 1990. Egg found on Bouteloua gracilis (0-100); egg found on top of young Cirsium ochrocentrum leaf among B. gracilis patch (B. gracilis 0-100, Stipa comata 15, 35, 60, 70, Andropogon scoparius 50, 80, 90); Apex Gulch, Jefferson Co. Colo., Sept. 5, 1991. Females prefer to oviposit on Bouteloua gracilis, and rarely oviposit on Bouteloua curtipendula, Sporobolus cryptandrus, Bromus tectorum dead seeds, and Carex probably pennsylvanica heliophila. Lab larvae eat Poa pratensis etc. (Scott 1975c). Eggs always hatch in the lab, but larval growth in the lab is much slower than that of Hesperia juba, so that larvae apparently hibernate in nature: usually as 1st stage, perhaps sometimes as 2nd stage. EGG white, turning pale pinkish in color (juba and comma eggs stay whitish), lacking a flange (H. comma has a basal flange, H. juba lacks it or has a very slight flange), larger than eggs of juba and comma. FIRST-STAGE LARVA cream (some larvae definitely pale yellow) with black collar and head like other Hesperia, neck light pinkish in front of collar, anterior seta on A10 very long (short in juba & comma).

Hesperia pahaska Leuss. Ovipositions 9:35, 10:46, 12:05, 13:38, 14:20, 14:27 on underside of leaves (usually near the outer edge of the clump) of Bouteloua (Chondrosium) gracilis, 1 mi. up Bear Creek, Chaffee Co. Colo., June 1969 and June 1970 (Scott 1974a reports movements and behavior at this site). Egg (#75, egg slightly larger than H. nevada egg, 1st stage larva D1 and D2 equally long on A10 like pahaska) found on Bouteloua gracilis large clump (B. gracilis 30-100, Agropyron [Elymus="Sitanion"] longifolius 55, 1 m, old Bromus [Anisantha] tectorum 20, 20, few, Vulpia octoflora 1 m, Stipa comata 1 m), egg (#79, 1st stage larva D1 as long as D2) found on Bouteloua gracilis (B. gracilis 20-1 m, old Bromus tectorum 20 fairly common, Stipa comata 40, 40, 40, 80, etc.), N Beaver Brook, Jefferson Co. Colo., June 22, 1988. Egg (#108, 1st stage larva pahaska, perhaps viridis) found on Bouteloua gracilis (B. gracilis 0-1 m, old Bromus japonicus 10 scattered, Stipa comata 70, 80, 80, 80, 1 m, Carex rossii 10), Red Rocks, Jefferson Co. Colo., July 4, 1988. Females prefer to oviposit on Bouteloua gracilis. Half-grown larvae must hibernate. Eggs and first-stage larvae are virtually identical to those of H. viridis.

Hesperia viridis (Edw.). Oviposition Bouteloua (Chondrosium) gracilis, 1 mi. up Bear Creek, Chaffee Co. Colo., June 1969/June 1970. Preoviposition 9:45 she failed to land on Oryzopsis exiguua or Andropogon gerardii; preoviposition 10:35 bent abdomen 6 times Bouteloua gracilis; this B. gracilis patch was then searched for eggs: egg (probably viridis but did not hatch) and 1st stage larva (lost) (#102) found on Bouteloua gracilis (B. gracilis 0-1 m, old Bromus japonicus 3 cm scattered, Agropyron [Elymus="Sitanion"] longifolius 1 m, Poa compressa 40-55, Stipa comata 60, 60, 70), egg (#103, probably viridis but lost) found on Bouteloua gracilis (B. gracilis 0-1 m), egg (#104, larva viridis) found on Bouteloua gracilis (B. gracilis 0-1 m, Agropyron [Elymus="Sitanion"] longifolius 70), egg (#105, larva viridis) found on Bouteloua gracilis (B. gracilis 0-1 m, Oryzopsis exiguua 40-50, 90, old Bromus japonicus 10 scattered, Poa compressa 80, Agropyron [Elymus="Sitanion"] longifolius 50, 70, 1 m), egg (#106, probably viridis but did not hatch) found on Bouteloua gracilis (B. gracilis 0-1 m, Stipa comata 20, 20, 25, 30 onward, old Bromus japonicus 15 rare, Andropogon gerardii 60, Agropyron [Pascopyrum] smithii 35, 50, 70, 80), 2 eggs (#107, probably viridis but did not hatch) found on Bouteloua gracilis (B.

gracilis 0-1 m, old Bromus japonicus 5 scattered, Agropyron [Elymus="Sitianion"] longifolius 30, Stipa comata 35, 50, 60 onward), 2 eggs (#108, 1 larva viridis, other egg did not hatch) found on Bouteloua gracilis (B. gracilis 0-1 m, old Bromus japonicus 10 scattered, Stipa comata 70, 80, 80, 80, 1 m, Carex rossii 10), egg (#109, probably viridis but did not hatch) found on Bouteloua gracilis (B. gracilis 0-1 m, old Bromus japonicus 15 scattered, Agropyron [Pascopyrum] smithii 8, 40, 50, 70, 80, Stipa comata 60, 1 m, Carex probably pennsylvanica heliophila 90); Bouteloua gracilis was uncommon here and the patch of short plants was very hot from the sun which perhaps explained the mortality of most of the exposed eggs; some of the eggs that did not hatch could have been H. pahaska; Red Rocks, Jefferson Co. Colo., July 4, 1988. Egg (probably viridis, perhaps pahaska, based on egg and 1st stage larva) found on Bouteloua gracilis (B. gracilis abundant 0-100 cm, Stipa comata 100, Sporobolus cryptandrus 35-55, 50, common 75, green Bromus japonicus scattered 3-100, dead Bromus [Anisantha] tectorum scattered 5-100, Agropyron [Elymus="Sitianion"] longifolius 95), Chimney Gulch, Jefferson Co. Colo., June 27, 1989. Egg found 13:04 on Bouteloua gracilis (B. gracilis 0-40 cm away, Stipa comata 20-25, 50-90, Carex probably pennsylvanica heliophila 35-50, 80-110, Bromus tectorum 10); 2 eggs found 13:11 on Bouteloua gracilis 15 cm apart (B. gracilis 0-~40, Aristida purpurea ~75, Stipa comata ~30, abundant ~40-100, Carex probably pennsylvanica heliophila ~55-90); egg found 13:22 on Bouteloua gracilis (B. gracilis 0-40, 80-110, Stipa comata 15, common 30-100, Bouteloua curtipendula 80-120); egg found 13:32 on Bouteloua gracilis (B. gracilis 30-45, 50-120, Stipa comata 20, 30, 45, 60, 80-200); egg (did not hatch, probably viridis) found 13:35 on Bouteloua gracilis (B. gracilis 30-50, 40-80, 70-110, Stipa comata common 20-35, 50, 60, etc., Bromus japonicus 20, Koeleria macrantha 90, Aristida purpurea 90); all eggs were determined to be probably H. viridis, or possibly H. pahaska, based on egg shape, setae of hatched first-stage larva, adult abundance and habitat, except the last egg; Red Rocks, Jefferson Co. Colo., June 25, 1989. 3 eggs (H. viridis or pahaska) found on Bouteloua gracilis (B. gracilis 0-20, Stipa comata 25-45, Aristida purpurea 100); Falcon County Park, Jefferson Co. Colo., July 18, 1990. Oviposition 10:40 Bouteloua curtipendula (W), Chimney Gulch, Jefferson Co. Colo., July 17, 1978. 2 larvae 7 & 12 mm long found on Bouteloua curtipendula, in silk-tube nests (of silked dead leaves and sand grains) in soil just below surface, the leaves chewed nearly to stumps around nest (2 males reared, emerged Oct. 18-19); S-facing slope, Apex Gulch, Jefferson Co. Colo., Aug. 27, 1990. Empty horizontal silk web nest (H. viridis? or comma?) found in litter in Bouteloua curtipendula clump; Apex Gulch, Jefferson Co. Colo., Sept. 19, 1990. Oviposition 10:10 on underside of leaf of Andropogon gerardii, Red Rocks, Jefferson Co. Colo., July 2, 1986. Bouteloua gracilis is the main host; Bouteloua curtipendula is sometimes chosen, Andropogon gerardii rarely. Half-grown larvae must hibernate. MATURE LARVA dark brown; head & collar black (no cream stripes, unlike H. ottoe). PUPA resembles H. ottoe, pale brown, abdomen pink-tan (as in some ottoe), intersegmental areas chitin-brown, orbit brown, T1 spiracle pink, head & thorax & dorsal edge of wing with blackish-brown fine mottling (light on one pupa, dark on other), A2-7 (very faint A1) have 3 transverse rows of short blackish-brown dashes, A4-5 each have a supraventral hairy mound, proboscis tip orange and extends just beyond A4 or extends to A5, cremaster red-brown, fairly short (lateral margins convex), antenna becomes red prior to emergence, then adult wings become visible etc.

Hesperia attalus attalus (Edw.). Adults associated with Bouteloua curtipendula, S of Hopeton, Woods Co. Okla., Sept. 3, 1986.

Hesperia nevada ssp. (ventral hindwing slightly more ochre-brown than green). Preoviposition 11:03 Poa pratensis then probably Agropyron (Pascopyrum) smithii; egg found (#1) on underside of Koeleria macrantha leaf in a clump which had 1/4 of clump consisting of Festuca saximontana 1 cm from egg (K. macrantha common 10, 20, 20, 30-80 cm etc., F. saximontana 5 scattered clumps common, Danthonia parryi 60, 60, 90-100 cm, Agropyron [Elymus="Sitianion"] longifolius 70 cm, Oryzopsis exiguua common 10-100); all Guy Hill, Jefferson Co. Colo., June 15, 1988. Preoviposition 10:30 Poa pratensis; oviposition (egg #2) 10:59 beneath Koeleria macrantha leaf (K. macrantha common 15, 25, 30, 30, 40, cm etc., Festuca saximontana 2, 10, 20, 40 cm onward, Oryzopsis exiguua 10-20, 25-30 cm etc., Danthonia parryi 20-25, 50, 80 cm etc., Poa pratensis 10, 15, 25, thick 40-100, Carex probably pennsylvanica heliophila 20-100 cm); egg (#3) found on underside of Poa pratensis leaf (P. pratensis common all around, Agropyron [Pascopyrum] smithii 15, 20, 30, 30, 45, 60 cm etc., old Bromus [Anisantha] tectorum scattered 10 cm onward, Festuca saximontana 20, common 40 cm onward, Agropyron [Elymus="Sitianion"] longifolius 30, 45, 50, 70 cm, Carex probably pennsylvanica heliophila 1 m, Bouteloua [Chondrosium] gracilis 80-90); egg (#4) found Festuca saximontana (F. saximontana common all around, Koeleria macrantha

10, 15, common 20-100, Agropyrum [Pascopyrum] smithii 70-90; all Guy Hill, Jefferson Co. Colo., June 16, 1988. Oviposition (egg #5) 9:03 (she hovered for ~20 sec in large Poa pratensis swale before laying) on edge of Danthonia parryi grass blade (D. parryi 0-30, 60 cm, 1 m, Bromus [Bromopsis] inermis 60 cm, Stipa comata 70, 80, 1 m, Poa pratensis very thick 15-100 cm, Carex probably pennsylvanica heliophila 3, 8, 20, 40 cm etc., Koeleria macrantha 30, 35, 80, Festuca saximontana 20, 40); 2 eggs (#6) found on Festuca saximontana leaves (F. saximontana common 10 cm onward, Koeleria macrantha 30 cm onward, Oryzopsis exigua thick 40, 70, 80, 1 m, Danthonia parryi 30 cm, Carex probably pennsylvanica heliophila 50 cm, Agropyrum [Pascopyrum] smithii 1 m, Bouteloua gracilis 80 cm, Poa aquassizensis 50 cm, old Bromus tectorum scattered 15 cm onward); 2 eggs (#7) found on Festuca saximontana (F. saximontana thick 5, 25, 30 cm onward, Carex probably pennsylvanica heliophila 10-25, 25, 35, 40 cm, Oryzopsis exigua 1 m, Koeleria macrantha common 3, 10, 10, 20 cm etc. onward, Poa nemoralis interior 80-90, old Bromus tectorum 30 cm); egg found (#8) on underside of Koeleria macrantha leaf (K. macrantha common 5 cm onward, Festuca saximontana common 20 cm onward, Oryzopsis exigua thick 50-90, Agropyrum [Pascopyrum] smithii 30, 50, 60, old Bromus tectorum 30-80, 1 m); egg found (#9) on underside of Koeleria macrantha leaf (K. macrantha 10, 15, 20, 30, 35, 50 cm onward, Agropyrum [Pascopyrum] smithii 8, 30, 50, 60, Festuca saximontana 2, 15, 18, 20 cm etc. onward, Oryzopsis exigua 30-70, 80, old Bromus tectorum 25, 40-100); egg found (#11) Festuca saximontana (F. saximontana 5, 10, 25 cm etc. onward, Agropyrum [Pascopyrum] smithii 30-100, Carex probably pennsylvanica heliophila 20, 30-100, Bouteloua gracilis 5-25, 20-30, 30-40 cm onward, Oryzopsis exigua 80-100, old Bromus tectorum 15-100, Koeleria macrantha 40, Stipa comata 40, 70, 1 m, Agropyron [Elymus="Sitanion"] longifolius 20-25); egg found (#12) Festuca saximontana (F. saximontana thick 0-100 cm, Koeleria macrantha 3, 15, 18, 20 cm etc. onward, Oryzopsis exigua 75-90, Bouteloua gracilis 50-100); egg found (#13) on Stipa comata tiny clump (possibly Koeleria macrantha as no other Stipa nearby) (Koeleria macrantha scattered common 10 cm onward, Festuca saximontana 1, 10, 15, 20 cm etc. onward, Oryzopsis exigua 60, 60-90, Agropyrum [Pascopyrum] smithii 10, 20-40, etc., Danthonia parryi 80-100); egg found (#14) Festuca saximontana (F. saximontana thick 0-100, Koeleria macrantha common 2, 5, 15 cm onward, Bouteloua gracilis 2 blades 2 cm from egg and 35-50, Stipa comata 10, 25, 40, Agropyrum [Pascopyrum] smithii 50, 60, 60, 80, Poa pratensis 60-80, Oryzopsis exigua 90-100); oviposition (egg #15) Stipa comata (S. comata 40, 45, 80 cm, Koeleria macrantha common 5, 10, 15, 20, 40-50 etc., old Bromus tectorum 30-100, Festuca saximontana 2, 5, 15, etc., Bouteloua gracilis thick 5-100, Poa pratensis 70-90, Agropyrum [Pascopyrum] smithii 80); egg found (#16) Stipa comata (S. comata 20, 30, 40, Bouteloua gracilis thick 0-100, Festuca saximontana common 10 cm onward, Agropyrum [Pascopyrum] smithii 9-100, old Bromus tectorum 35-100, Poa pratensis 110, Koeleria macrantha 40, 50-60, 60, 1 m); egg found (#17) on Festuca saximontana (F. saximontana 5, 8, common 25 cm onward, Agropyrum [Pascopyrum] smithii 30, 40, 30-100, Bouteloua gracilis 0-100, old Bromus tectorum 20-100, Stipa comata 10, 20, 30 cm onward, Poa pratensis 1 m); egg found (#18) Festuca saximontana (F. saximontana 15, 25, 30 cm etc. common, Bouteloua gracilis thick 5-1 m, Poa pratensis 10, 30-100 scattered, Koeleria macrantha 20, 40, 50, 70, 90-100, Agropyrum [Pascopyrum] smithii scattered 15 cm onward, Stipa comata uncommon 10); egg found (#19) Festuca saximontana (F. saximontana 10, 15, 15 cm onward, Poa pratensis scattered 50 cm onward, Koeleria macrantha 20-30, 40, 50, Agropyrum [Pascopyrum] smithii 10, 30, 30, 30, 55, etc., Bouteloua gracilis 25-1 m, Stipa comata 40, 50, uncommon, old Bromus tectorum 50, 80-100); red-and-black ants were common near most eggs on this day; all Guy Hill, Jefferson Co. Colo., June 17, 1988. 1 egg found (#20) on Koeleria macrantha (K. macrantha 0-15, 15, 20, 20, 35, 40, 50 etc. common, Festuca saximontana 5, 10, 15, 20, etc. common, Poa pratensis 80, Agropyrum [Pascopyrum] smithii 70, 80, old Bromus tectorum 20, 60-100, Bouteloua gracilis 1-5, 9, 10, 20, etc. common, Stipa comata 5, 10, 12, 15, 25 etc. common); 1 egg found (#21) on underside of Festuca saximontana leaf (F. saximontana 20, 25, 30, 30, 60, 70 cm etc. not common, Koeleria macrantha thick 3, 3, 10, 15, 20-30 onward, Oryzopsis exigua 6, 15-25, 30, 50-100, Danthonia parryi 5-7, 9-120, Stipa comata 20, 25, 35, 90, Carex probably pennsylvanica heliophila 10, 10, 20, 20 cm onward); egg found (#24) on Stipa comata (S. comata 2, 15, 20, 25, 50, 80, Bouteloua gracilis 1, 5, 7, 15-1 m, Koeleria macrantha 5, 8, 30, 30, 35, 30-40 etc., Festuca saximontana 20, 25, 30, 35, 40, 40, 40-100, Agropyrum [Pascopyrum] smithii 25, 90, Poa pratensis 1 m); egg found (#25) Festuca saximontana (F. saximontana 8, 20, 25, 30 cm onward, Koeleria macrantha 20, 25, 60, 70 cm common, Bouteloua gracilis 1-5, 8, Stipa comata 25, Danthonia parryi 15, 20, 25-50, 1 m, Carex probably pennsylvanica heliophila 8 cm common all over, Poa nemoralis interior 25, 40, Agropyron [Elymus="Sitanion"])

Longifolius dead 40, Oryzopsis exigu 40, 90, Agropyrum [Pascopyrum] smithii 40); egg found (#26) Festuca saximontana (F. saximontana 25, 30, 30, 80-100, Oryzopsis exigu 20-40, 40-90, Poa pratensis 90-110, Danthonia parryi common 3-100, Carex probably pensylvanica heliophila 5, 15-20, 40-100, Koeleria macrantha 30, 50, 50, 60, 100, old Bromus tectorum 50, Bouteloua gracilis 50); egg found (#27) Festuca saximontana (F. saximontana 5, 10, 10, 15, 25 cm onward, Oryzopsis exigu 10-25, 20-80, 50-100, Koeleria macrantha 30, 30-40, 60, 60, 70, Poa compressa 15-20, 20, 30-40, 60, 70, Danthonia parryi 10, 50-60 onward, Carex probably pensylvanica heliophila 70, Stipa comata 1 m, Agropyron [Elymus="Sitanion"] longifolius 50); egg found on (#28) Festuca saximontana (F. saximontana 5, 10, 12, 15 cm, 20 thick onward, Stipa comata 20, 25, 25, 30, 30, 45 cm onward, Elymus longifolius 35, Koeleria macrantha 15, 55, Bouteloua gracilis 35-40, 40, Agropyrum [Pascopyrum] smithii 40, old Bromus tectorum 90-100); egg found on (#29) Oryzopsis exigu (O. exigu 1-30, 25-40, 30-40 etc. common, Poa pratensis 15, 30, 40-100, Festuca arizonica 70-75, Danthonia parryi 25-35, 30, 40-100, Koeleria macrantha 70-80, Carex probably pensylvanica heliophila 15, 40, 50, 60, Koeleria macrantha 40-80, Festuca saximontana 12, 20, 1 m, Agropyrum [Pascopyrum] smithii 30); egg found on (#30) Festuca saximontana (F. saximontana 30, 30, 1 m, Stipa comata 10, 12, 15, 15, 20 cm onward common, Oryzopsis exigu 80, Bromus [Bromopsis] inermis 40-50, Danthonia parryi 20, 50-90, old Bromus tectorum scattered 4 cm onward, Agropyrum [Pascopyrum] smithii 15-25, 60, Agropyron [Elymus="Sitanion"] longifolius 60); all Guy Hill, Jefferson Co. Colo., June 19, 1988. Preoviposition 12:10 she did not land in Poa pratensis meadow, she hovered under shrubs and crawled under one shrub; egg (#31) found on Festuca saximontana (F. saximontana 15, 25, 40, 40, 70 etc. common, Agropyron [Elymus="Sitanion"] longifolius 70, Carex probably pensylvanica heliophila 10, 25, 30, 30, 50 etc., Stipa comata 5, 10, 20, 25, 40, 50, Bouteloua gracilis 5-10, 15, old Bromus tectorum 5, scattered, 60-100, Koeleria macrantha 20, Danthonia parryi 90-120); egg found on (#32) Festuca saximontana (F. saximontana 20, 50, 50-80, etc., Agropyron [Elymus="Sitanion"] longifolius 20, Koeleria macrantha 15-25, 25, thick, Carex probably pensylvanica heliophila 60 onward, Poa pratensis 50-100, old Bromus tectorum 15 scattered, Stipa comata 10, 15, 20, 20, 25 cm onward common, Bouteloua gracilis 10, 15, 35-40, 50-80, Agropyron [Elymus="Sitanion"] longifolius 80, 80, Bromus [Bromopsis] inermis 1 m); egg found on (#33) Festuca saximontana (F. saximontana 10, 15, 15, 20, 25, Bouteloua gracilis 3-15, 10, Stipa comata 15, 20, 20, 25, 30, etc. common, old Bromus tectorum 4 all over, Poa pratensis 40-100, Vulpia octoflora 3-100, Bromus [Bromopsis] inermis 1 m); egg (#34) found on Festuca saximontana (F. saximontana 2, 10, 15, 25, 30 etc. common, Stipa comata 5, 6, 8, etc. common, Agropyron [Elymus="Sitanion"] longifolius 5, old Bromus tectorum 5 scattered, Poa pratensis 50-100, Bouteloua gracilis 10, 20-30, 50, Vulpia octoflora 10 scattered, Agropyrum [Pascopyrum] smithii 15, 80, 1 m); 2 eggs (#35) found on Stipa comata (S. comata 35, 50, Poa pratensis 15, 15, 20, common 30 cm onward, Agropyrum [Pascopyrum] smithii 60-90, Bouteloua gracilis 30); egg (#36) found on Stipa comata (S. comata 10, 20, 25, 35-100, Festuca saximontana 10, 45, Bouteloua gracilis 15-100, Poa pratensis 70 onward, Vulpia octoflora 30 etc., old Bromus tectorum 30 onward); 2 eggs (#37) found on Festuca saximontana (F. saximontana 10, 15, 20, 25, 30, 80, 80, Bouteloua gracilis 10-40, 30, 30, 70-100, Poa pratensis 80 onward, old Bromus tectorum 1 m, Vulpia octoflora 1 m); egg (#38) found on Stipa comata (S. comata 5-40, 10, 15, 15-25 etc. common, old Bromus tectorum thick 0.5-100); preoviposition 10:10 Festuca saximontana, egg (#39) found on Festuca saximontana (F. saximontana 12, 15, 20, 25, 30-40, 45 etc. common, Agropyron [Elymus="Sitanion"] longifolius 8, 15, 20, 40-50, 60, Stipa comata 5, 15, common 25, 30, 30, Poa compressa 50-100); 3 eggs (#40) found (1 egg on dead leaf perhaps of Carex in Koeleria macrantha clump, 2 eggs piled on top of each other on Koeleria macrantha leaf)(K. macrantha 50 cm and perhaps closer, 1 m, Agropyrum [Pascopyrum] smithii 15, Festuca saximontana 15, 25, 30, 40-100, Bouteloua gracilis 10, 15, 40-50, Stipa comata 15, 40, 50 onward, Carex probably pensylvanica heliophila 25, 40, 40, 40, 45 onward, old Bromus tectorum 10, 20, 40, 80-90, Agropyron [Elymus="Sitanion"] longifolius 25); egg (#41) found on Festuca saximontana (F. saximontana 10, 20, 30 cm etc. common, Koeleria macrantha 30, 40, 45, 50, 50-100, Bouteloua gracilis 2-30 common, Stipa comata 25, 30, Poa pratensis 15, Agropyron [Elymus="Sitanion"] longifolius 20, 40); egg (#42) found on Koeleria macrantha (K. macrantha 5, 15, 25, to 1 m, Festuca saximontana 3, 10, 15, etc. common, Bouteloua gracilis 12-50, 60-100, Stipa comata 12, 30 uncommon, Agropyron [Elymus="Sitanion"] longifolius 20, 40, 60, Poa pratensis 60-100); egg (#43) found on Festuca saximontana (F. saximontana 15, 20, 30, 40 onward, Koeleria macrantha 8, 10, 15, 20, 25, 30-100 common, Bouteloua gracilis 10, 15, 30, 30, common onward, Poa pratensis 50-100, Carex probably pensylvanica heliophila 60, 75, Stipa comata 3 clump, 20, Danthonia

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parryi 50-60, Agropyron [Elymus="Sitanion"] longifolius 80, 90; egg (#44) found on Festuca saximontana (F. saximontana 25, 30, 30, 30, 65, 70 etc., Koeleria macrantha 10, 25-100 common, Poa pratensis 15, 20, 40-100, Carex probably pennsylvanica heliophila 20-25, Bouteloua gracilis 25-100, Danthonia parryi 20, 25-30, Stipa comata 30 etc., 70); egg (#45) found on Koeleria macrantha (K. macrantha fairly common, Festuca saximontana 10, 20, 35, 40, etc., Agropyron [Elymus="Sitanion"] longifolius 15, 20, 20, 25 etc., old Bromus tectorum 10, 30-100, Bouteloua gracilis thick 0-100, Stipa comata 25, Poa pratensis 30-100, Carex probably pennsylvanica heliophila 50-100, Danthonia parryi 1 m, Bromus [Bromopsis] inermis 95); 6 eggs (#46) within 40 cm of each other found on Festuca saximontana (F. saximontana common, Bouteloua gracilis common, Carex probably pennsylvanica heliophila scattered, Danthonia parryi 20 or 50, Poa pratensis ~90 onward, Agropyron [Elymus="Sitanion"] longifolius uncommon 30 cm onward, Oryzopsis exiguua 60 cm onward, Poa nemoralis interior 60 or 90, Stipa comata 20 cm onward); 2 eggs (#47) found on Koeleria macrantha (K. macrantha 22, 30, 30, etc. onward, Stipa comata 8, 8, 15, 15, etc. onward, Bouteloua gracilis 2, 5-20, 60, 70-100, Carex probably pennsylvanica heliophila 6, 10, 15, 20, etc., Festuca saximontana 20, 20, 20, Agropyron [Elymus="Sitanion"] longifolius 80, 1 m, Oryzopsis exiguua 1 m, Danthonia parryi 90-130); egg (#48) found on Koeleria macrantha (K. macrantha 30, 50-1 m, Stipa comata 6, 12, 20, 30, 40, 55, etc., Agropyron [Elymus="Sitanion"] longifolius 18, 35, 40, old Bromus tectorum 30, 50, Danthonia parryi 15-60, Oryzopsis exiguua 45-60, Festuca saximontana 1 m); egg (#49) found on Festuca saximontana (F. saximontana 10, 10, etc. common, Bouteloua gracilis 8-100, Koeleria macrantha 30, Carex probably pennsylvanica heliophila 10, 30, rare, old Bromus tectorum 10 scattered, Agropyron [Pascopyrum] smithii 80, Stipa comata 15, 15, 15, 30, 30); egg (#50) found on Stipa comata and egg (#51) found on Festuca saximontana within 10 cm of egg #50, (S. comata 15, 15-30, 20 common, F. saximontana 25, 30, 30, 35, 50, etc. common, Danthonia parryi 20-100, Koeleria macrantha 12, 35, 50, 70, Bouteloua gracilis 60, Agropyron [Elymus="Sitanion"] longifolius 70, Carex probably pennsylvanica heliophila 80, Bromus [Bromopsis] inermis 40-45, Poa pratensis 70 one clump, 90, old Bromus tectorum 50-1 m); egg (#52) found on Koeleria macrantha (K. macrantha 35, 80, Stipa comata 5, 7, 10 very common, Bouteloua gracilis 12, 20-45, Festuca saximontana 7, 30, 50, 50, Agropyron [Elymus="Sitanion"] longifolius 40, 60, 80-100, old Bromus tectorum 10 scattered, Carex probably pennsylvanica heliophila 40-70, Poa pratensis 40, Bromus [Bromopsis] inermis 20-40); egg (#53) found on Festuca saximontana (F. saximontana 3, 10, 20, 45, 25-30, 90, Bouteloua gracilis 7, 20, 20, 40, etc., Stipa comata 5, 10, etc. very common, Carex probably pennsylvanica heliophila 45-90, Danthonia parryi 80 onward, Agropyron [Elymus="Sitanion"] longifolius 1 m, Oryzopsis exiguua 80); egg (#54) found on Koeleria macrantha (K. macrantha 15, 20, 20, 90, Stipa comata 15, 25, 25, 35 etc. common, Festuca saximontana 10, 15, 15, 25, 25, Bouteloua gracilis 13, 40-50, Carex probably pennsylvanica heliophila 8, 25, 25, 50-1 m, Danthonia parryi 50-80, 1 m); egg (#55) found on non-monocot (found 18 cm from egg #54 so not detailed separately, but nearest monocots were Bouteloua gracilis 8 etc., Carex probably pennsylvanica heliophila 10 etc., Festuca saximontana 10 etc.); egg (#56) found on Koeleria macrantha (K. macrantha fairly common 10 cm onward, Stipa comata 8, 20, 20, 30, 50, Festuca saximontana 20 common, Bouteloua gracilis 6, 8, 15, 20-100, Carex probably pennsylvanica heliophila 55, 60, 60, 60, etc., old Bromus tectorum 70 etc., Agropyron [Pascopyrum] smithii 15); 3 eggs (#57) found on Festuca saximontana (very near egg #56 so not detailed separately, but nearest grasses Koeleria macrantha 15-25, Agropyron [Pascopyrum] smithii 15-20, Festuca saximontana 3); egg (#58) found on Stipa comata (S. comata 5, 10, 15, 20-1 m, Festuca saximontana 5, 15, 25, 25, 50, 50, etc., Danthonia parryi 15, 20, 25-40, 50, Koeleria macrantha 15, 50, 90, Carex probably pennsylvanica heliophila 60, 60, old Bromus tectorum 10, 1 m scattered); egg (#59) found on Stipa comata (S. comata common, Festuca saximontana 2, 20, 50, 50, old Bromus tectorum 10 scattered, Carex probably pennsylvanica heliophila 40, 40, 40, etc., Danthonia parryi 50, 65 onward, Koeleria macrantha 40, 50, 50, 65, 70, Bouteloua gracilis 50); egg (#60) found on Koeleria macrantha (K. macrantha 10, 20, 1 m, Poa nemoralis interior 1 m, Stipa comata 3, 10, 15, 15, 20-100, Bouteloua gracilis 10-100, Carex probably pennsylvanica heliophila 15, 15, 50-100, Danthonia parryi 25-35, Festuca saximontana 30, 30, 45, 90, etc., Agropyron [Elymus="Sitanion"] longifolius 15, 35); egg (#61) found on Stipa comata (S. comata 20, 20, 20, 30, 35, etc. common, Agropyron [Elymus="Sitanion"] longifolius 5, 20, 80, Bouteloua gracilis 15, 20-40, 40, etc., Danthonia parryi 30-40, 40-55, Carex probably pennsylvanica heliophila 35, old Bromus tectorum 5 scattered common 20-1 m, Festuca saximontana 90); egg (#62) found on Festuca saximontana (F. saximontana 5, 5, 5, 20, 20, 20, 20, common, Koeleria macrantha 5-10, 15, 30, 35, 55, 80, 1 m, Danthonia parryi 20-100, Stipa comata 12, 15, 20

common, Carex probably pennsylvanica heliophila 20, old Bromus tectorum 25, Agropyrum [Pascopyrum] smithii 40, Bouteloua gracilis 15, 50-70, 70); egg (#63) found on Festuca saximontana (F. saximontana 10, 30, 30, 40, 70, Koeleria macrantha 20, 25, 25, 45, 50-100, Stipa comata 10-30, 35, common, Danthonia parryi 50-1 m, Oryzopsis exiguua 25-50, Agropyrum [Pascopyrum] smithii 45, Carex probably pennsylvanica heliophila 10, 15, 20, 40, 60 etc., old Bromus tectorum 1 m, Bouteloua gracilis 60-1 m); all Guy Hill, Jefferson Co. Colo., June 20, 1988. Egg (#65) found on Festuca saximontana (F. saximontana 8, 20, 30, etc. thick, Danthonia parryi 18, 20-100 thick, Oryzopsis exiguua 12-25, 50-80, Bouteloua gracilis 10-100 thick, Carex probably pennsylvanica heliophila 25, 30, 40 etc., Koeleria macrantha 80, 1 m); egg (#66) found on Festuca saximontana (F. saximontana 15, 20, 20, 25, 25, etc., Stipa comata 10, 20, 20, etc., Bouteloua gracilis 8, 5-1 m, Carex probably pennsylvanica heliophila 12, 15, 15, 25, 30, Danthonia parryi 40-70, Koeleria macrantha 60, Poa nemoralis interior? 1 m); egg (#67) found on Festuca saximontana (F. saximontana 15, 25, 30, 30, 40, etc., Bouteloua gracilis 3, 8, 15, 15-100, Stipa comata 8, 15, 20, 30, 35, 50, etc., old Bromus tectorum 80, Vulpia octoflora 1 m); 2 eggs (#68) found (the first on Festuca saximontana the second on Stipa comata leaf of tiny plant touching the F. saximontana) (F. saximontana 40, 50, 1 m, S. comata 1, 4, 12, 15, 20, etc. common, Carex probably pennsylvanica heliophila 20, Koeleria macrantha 40, Bouteloua gracilis 8-100, Vulpia octoflora 60, Danthonia parryi 90, Agropyron [Elymus="Sitanion"] longifolius 70, Oryzopsis exiguua 40-55, 60-70); egg (#69) found on Festuca saximontana (F. saximontana 15, 25, 25, 40, etc., Koeleria macrantha 40, 40, Stipa comata 5, 15, 20, 20, 20, etc. Oryzopsis exiguua 15, 25, 25-35, etc.); egg (#70) found on Koeleria macrantha (K. macrantha 80, 1 m, Stipa comata 25, 70, 80, 80, Agropyron [Elymus="Sitanion"] longifolius 18, 20, 30, 40, 70, 70, 80, 1 m, Carex probably pennsylvanica heliophila 10-100, Festuca saximontana 70, Bouteloua gracilis 15-20, 30, 40-100, old Bromus tectorum thick sward 8-100, Danthonia parryi 80, 80-100); egg (#73) found on Festuca saximontana (F. saximontana 5, 5, 10, 13, 20, 20 onward, Stipa comata 30, 70, Poa compressa 60, Danthonia parryi 18-100, Poa pratensis 50 onward, Koeleria macrantha 15, 30, 40, 1 m, Carex probably pennsylvanica heliophila 40, 60, etc., Bouteloua gracilis 20-40, Agropyrum [Pascopyrum] smithii 30, 30, 80-100); all Guy Hill, Jefferson Co. Colo., June 21, 1988. Egg (#74, first stage larva D1 2/3 length of D2 on A10 as in nevada) found on Festuca saximontana (F. saximontana uncommon at this locality, 25, 30, 50, 55, 55, 60, 1 m, 1 m, Oryzopsis exiguua 10-30, 30, 40, 50-1 m, Carex probably pennsylvanica heliophila 80, 90); egg (#76, 1st stage resembles nevada) found on Bouteloua gracilis (B. gracilis common 8 cm onward, Oryzopsis exiguua 30, 30, 50, 70, Carex probably pennsylvanica heliophila 25, 30, 30 onward common, Agropyron [Elymus="Sitanion"] longifolius 80); both N Beaver Brook, Jefferson Co. Colo., June 22, 1988. At this locality I searched ~150 Bouteloua gracilis, ~50 Festuca saximontana, ~25 Festuca arizonica, ~40 Oryzopsis exiguua (the most common grass), ~40 Carex probably pennsylvanica heliophila, ~25 Koeleria macrantha, ~20 Stipa comata, ~4 Agropyron [Elymus="Sitanion"] longifolius. Oviposition (#97) 15:30 on underside of Aster ericoides? leaf near stem (Poa pratensis 8, 20-1 m, 35-1 m common [egg at upper end of big swale of this], Stipa comata 5, 10, 15, 15, 15-1 m, 20, common, Koeleria macrantha 15, 15-30, 25, 30, 45 onward, Agropyron [Elymus="Sitanion"] longifolius 25, 25, 70); egg (#98) found (15 cm from egg #97) on 2-cm Solidago seedling leaf underside under Koeleria macrantha (K. macrantha 15 etc., Stipa comata 8-1 m, Poa pratensis 25 etc.); both Guy Hill, Jefferson Co. Colo., June 27, 1988. Egg found 9:57 on Bouteloua gracilis (B. gracilis 0-20, abundant to 1 m, Bromus tectorum common 2-100 cm, Stipa comata common 15-70 cm etc., Agropyron [Elymus="Sitanion"] longifolius 30, 60 cm, Danthonia parryi 40-60 cm, Vulpia octoflora 5, 10, 15, Carex probably pennsylvanica heliophila 1 m); egg found 10:53 on Festuca saximontana (F. saximontana common 0-60 cm, Stipa comata 5, 20-40 cm etc. common, Carex probably pennsylvanica heliophila 10-15, 50-1 m, Danthonia parryi 60-80, Oryzopsis exiguua 60-90, Bouteloua gracilis 3-40, common 40-100 cm, Poa pratensis 25, 45, 70); egg found 11:05 on Festuca saximontana (F. saximontana common 5-90 cm, Poa compressa scattered 5-50 cm, Agropyron [Elymus="Sitanion"] longifolius 5, 10, common 15-80 cm, Stipa comata 7, 20-50 common, Bouteloua gracilis 5-100 cm common, Bromus tectorum 10-100 cm, Poa pratensis 90 cm onward, Vulpia octoflora 20 cm, Carex probably pennsylvanica heliophila 50 cm, Bromus [Bromopsis] inermis 50-70 cm, Danthonia parryi 60-80 cm); 2 eggs found 11:17 on Festuca saximontana (F. saximontana 3, 10, 35, 60-90, Danthonia parryi 15-60, Poa nemoralis interior common 15-100, Poa pratensis 80-100, Bouteloua gracilis 40-60, Agropyron [Elymus="Sitanion"] longifolius 45, 80, Stipa comata 20, 35); egg found 11:50 on Festuca saximontana (F. saximontana 5-20, Agropyron [Elymus="Sitanion"] longifolius 5-50 common, Danthonia parryi 50-70, Bromus tectorum 20-100,

Oryzopsis exigu 80; Koeleria macrantha 20, 40, 85; Stipa comata 30; Bouteloua gracilis 40-150; egg found 12:04 on Festuca saximontana (F. saximontana 10, 30-50 etc., Agropyron [Elymus="Sitanion"] longifolius 6 cm onward common, Bromus tectorum 10, 20-100, Bouteloua gracilis 5-40); egg found 12:12 on Festuca saximontana (F. saximontana 7-30, 70, 70, Koeleria macrantha 20, Bouteloua gracilis 5-10, 20, 50-80, Stipa comata 5, 15-30 etc., Agropyron [Elymus="Sitanion"] longifolius 15-50 etc., Oryzopsis exigu 80); 2 eggs found 12:28 on Festuca saximontana (F. saximontana 5-40, 80-90, Koeleria macrantha 60, Agropyron [Pascopyrum] smithii 10, very common 15-100, Agropyron [Elymus="Sitanion"] longifolius 10, 20-30 etc. common, Stipa comata 20, 45, Bouteloua gracilis 5-40, Oryzopsis exigu 35-90); egg found 12:38 on Festuca saximontana (0-40, Poa pratensis 15, common 20-100, Oryzopsis exigu 40-60, Agropyron [Elymus="Sitanion"] longifolius 60, Agropyron [P.] smithii 10-20, 30-100 common, Stipa comata 20 etc.); egg found 12:48 on Festuca saximontana (F. saximontana 20-55, 90 etc., Koeleria macrantha 40, 100, Agropyron [Elymus="Sitanion"] longifolius 3, common 20-100, Agropyron [P.] smithii 60, 80, Stipa comata 30); egg found 13:05 on Festuca saximontana (F. saximontana 5, 15, 30-50, Oryzopsis exigu 40-50, Danthonia parryi 20, 65-80, Koeleria macrantha 30, Carex probably pensylvanica heliophila 10, 10-20, 60-70, Agropyron [Elymus="Sitanion"] longifolius 40-50, 100, Stipa comata 20, 20, 30, Bromus tectorum 5, Bouteloua gracilis 20-60); 2 eggs found 13:18 on Festuca saximontana (F. saximontana 20-35, 50, 80, Agropyron [P.] smithii 20-100, Danthonia parryi 100, Oryzopsis exigu 30-60, Poa pratensis 100, Stipa comata 70); egg found 13:35 on Festuca saximontana (F. saximontana 17, 90, Carex probably pensylvanica heliophila 10, Koeleria macrantha 7-30, 50, Agropyron [P.] smithii scattered 10-100, Stipa comata 45, 60, Oryzopsis exigu 25-30, 40-100, Bouteloua gracilis 5, 30-100, Danthonia parryi 30-50, Poa sp. 70-100); egg (did not hatch) found 13:43 on Koeleria macrantha (K. macrantha 40-60, Festuca saximontana 20, 30, Stipa comata 20, 25, common 35-100, Bouteloua gracilis 15-100, Carex probably pensylvanica heliophila 8-15, 40-100, Oryzopsis exigu 20-100, Bromus tectorum 90, Poa perhaps nemoralis interior 40, Agropyron [P.] smithii few); 2 eggs found 13:57 on 2 Bouteloua gracilis leaves 3 mm apart, next to Festuca saximontana (B. gracilis 7, 15, 15-100, F. saximontana 1-4, 10, 15, 20, 60, 90, Danthonia parryi 65-90, Festuca arizonica 60, 60-70, 100, Agropyron [Elymus="Sitanion"] longifolius 45, 45, Carex probably pensylvanica heliophila 40, 40-100, Stipa comata 25, Oryzopsis exigu 25, 25-40, 40-60, Poa pratensis 20-60, Bromus tectorum 3, scattered 15 onward, Koeleria macrantha 90); egg found 14:10 on Festuca saximontana (F. saximontana 20-30 onward, Agropyron [P.] smithii 8, 15, 20-100, Bromus tectorum scattered abundant 8 cm onward, Stipa comata 10, Danthonia parryi 5, 50-60, Koeleria macrantha 75, Bouteloua gracilis 40-50 etc., Poa pratensis 90); first egg found 14:15 on Festuca saximontana (F. saximontana 10, 15, 25-40, 60, etc.), second egg found 14:15 on Koeleria macrantha (13 cm from last egg)(for both eggs Poa pratensis ~25, Bromus tectorum scattered ~10-100, Danthonia parryi ~40-50, Oryzopsis exigu ~30, Poa compressa ~40, Bouteloua gracilis ~30-100, Stipa comata ~15, 25, 80, etc.); egg found 14:24 on Festuca saximontana (F. saximontana frequent 7-50, Bromus tectorum 15-100, Stipa comata 5, 45-50, Bouteloua gracilis 7, Poa pratensis 15, 40-100, Oryzopsis exigu 50-80, Koeleria macrantha 40-50, 100, Agropyron [P.] smithii 30, 40); egg found 14:34 on Festuca saximontana (F. saximontana 20, 20, 40-45, 70-80, Stipa comata 5, 10, 15, 40, 60, etc., Agropyron [Elymus="Sitanion"] longifolius 10, 30, 30, Danthonia parryi 20-100, Poa pratensis 30-100, Koeleria macrantha 25, 50-80); egg found 14:52 on Festuca saximontana (F. saximontana 5, 15, 20, 20-100, Bouteloua gracilis 25-100, Koeleria macrantha 5, Agropyron [P.] smithii scattered 35-100, Bromus tectorum scattered common 15-100, Agropyron [Elymus="Sitanion"] longifolius 20, common 40-100, Stipa comata 90); Guy Hill, Jefferson Co. Colo., June 19, 1989. Egg found 9:04 on Festuca saximontana (F. saximontana 5, 7, 12, 25-30, 50, 80-90, Bouteloua gracilis 60-90, Agropyron [Pascopyrum] smithii common 15-100, Stipa comata 6, Oryzopsis exigu 50-100, Bromus tectorum 30-100); 2 eggs found 9:15 on Festuca saximontana (F. saximontana 10-20, 30, 70-80, Poa nemoralis interior 22-100, Agropyron [Elymus="Sitanion"] longifolius 15, 25, Stipa comata 20, 40-55, Oryzopsis exigu 30-60, Carex probably pensylvanica heliophila 50-90); egg found 9:23 on Festuca saximontana (F. saximontana 5, 7, 10, common 20-100, Agropyron [Elymus="Sitanion"] longifolius 20, 25, 50, 60, Oryzopsis exigu 50-100, Koeleria macrantha 50, 80, Carex probably pensylvanica heliophila 1 m, Poa nemoralis interior 80-100, Danthonia parryi 60-80); egg found 9:33 on Koeleria macrantha (K. macrantha 10, 30, 40-60, 100, Bouteloua gracilis 15, Oryzopsis exigu 30-40, 15-60, Stipa comata 30-40, 65, Festuca saximontana 25, 40, 60, 70, Festuca arizonica 70-80, Carex probably pensylvanica heliophila 50-80, Bromus tectorum 35, 50-100); egg found 9:52 on Festuca saximontana (F. saximontana 10,

25, 35-50, 60, Bouteloua gracilis 30-50, Agropyron [Elymus="Sitanion"] longifolius 20, 60-100, Agropyron near [P.] smithii 40, 70-100, Oryzopsis exigu 15-40, Stipa comata 5, 30); 2 eggs 20 cm apart found 10:13 on Festuca saximontana (F. saximontana ~25, Oryzopsis exigu ~10-20, 30-70 etc., Danthonia parryi abundant ~20-100, Agropyron [P.] smithii ~20, 40, etc. common, Koeleria macrantha ~25, Bouteloua gracilis ~70-90, Bromus tectorum scattered ~20 onward, Stipa comata ~18, 20, 60); egg found 10:19 on Festuca saximontana (F. saximontana 5, Stipa comata 15, 15, 25, 80. etc. common, Poa pratensis 40-100, Koeleria macrantha 20, Bromus tectorum 10-100, Agropyron [P.] smithii 20, 20, 25-100, Danthonia parryi 20-40, 60, 100, Agropyron [Elymus="Sitanion"] longifolius 20); 2 eggs found 10:30 on Festuca saximontana in shade of Pinus ponderosa tree only 30 cm from trunk (F. saximontana 30-100 for first egg, 5-50, 60, 80, 100 for second egg, Bromus [Bromopsis] inermis ~25-50, 100, Stipa comata 60 and 30 for the two eggs, Koeleria macrantha ~40-100, Agropyron [P.] smithii ~60); egg found 10:39 on Koeleria macrantha (K. macrantha abundant 20-100, Agropyron [Elymus="Sitanion"] longifolius 8, 25, 30, Poa nemoralis interior 7, abundant 15-100, Oryzopsis exigu 45-80, 80-90, Danthonia parryi 20-45, 70-100, Festuca saximontana 45, 55, 80-80); 2 eggs found 10:51 on Festuca saximontana (F. saximontana 10, 10, 13, 20, 40, Danthonia parryi common 8-100, Bromus tectorum 10, 20-100, Koeleria macrantha 35, Stipa comata 10, 40-50, Agropyron [Elymus="Sitanion"] longifolius 50, Oryzopsis exigu 20-40, 50-60, 40-100, Bouteloua gracilis 40-100, Carex probably pensylvanica heliophila 20); egg found 11:05 on Koeleria macrantha (K. macrantha 15, 20-40, 30, etc. abundant, Bouteloua gracilis 30-50, Agropyron [Elymus="Sitanion"] longifolius 15, 20, Oryzopsis exigu 30-40, 45-100, Festuca saximontana 20, 20, 20, 50, 80-90, Stipa comata 15, 70, Poa pratensis 25-100); 2 eggs found 11:12 on Festuca saximontana (F. saximontana 5-90, Bouteloua gracilis 20-30, 30-100, Danthonia parryi 45-100, Oryzopsis exigu 20, Poa pratensis 40-100); egg found 11:20 on Festuca saximontana (F. saximontana 3, 10, 40, 60, Poa pratensis 20-100, Carex probably pensylvanica heliophila 25-70, Danthonia parryi 70-100, Agropyron [Elymus="Sitanion"] longifolius 20-30, 40, Oryzopsis exigu 45-60, 50-100, Bouteloua gracilis 15, 30-100, Stipa comata 50); egg found 11:26 on Koeleria macrantha (K. macrantha not nearby, Stipa comata 12, 15, 15, common 30-100, Agropyron [P.] smithii common 20-50, Danthonia parryi 65, Bouteloua gracilis 10-100, Agropyron [Elymus="Sitanion"] longifolius 20, 25, Oryzopsis exigu 100); egg found 11:31 on Stipa comata (S. comata 4, 15, 40, Poa pratensis 5, 10, abundant 10-100, Agropyron [Elymus="Sitanion"] longifolius 35, 60, Bouteloua gracilis 30-50, Carex probably pensylvanica heliophila 50-80, Bromus tectorum 90); egg found 12:07 on Festuca saximontana where ants were common (F. saximontana 3, 20, 30-80 etc., Carex probably pensylvanica heliophila 40-100, Bromus [Bromopsis] inermis 50, Bromus tectorum 40, Danthonia parryi 80, Oryzopsis exigu 20-40, 80, Agropyron [Elymus="Sitanion"] longifolius 30, 50, 60, Stipa comata 80, Koeleria macrantha 70, 80, 80, 100); egg found 12:18 on Festuca saximontana (F. saximontana 3, 5, 15, 25, 40-60, Koeleria macrantha 25, 30, 45-100, Agropyron [P.] smithii 30, Stipa comata 70, 70, Carex probably pensylvanica heliophila 15, Agropyron [Elymus="Sitanion"] longifolius 20, 30, 60, Festuca arizonica 50-60, Danthonia parryi 80-100); egg found 12:21 on Festuca saximontana (F. saximontana 0-20, 50, etc., Koeleria macrantha 25, 35, very common 50-90, Danthonia parryi 45-90, Agropyron [Elymus="Sitanion"] longifolius 15-20, 30, Stipa comata 90, Carex probably pensylvanica heliophila 50, Festuca arizonica 90, Agropyron [P.] smithii 20); egg found 12:29 on Festuca saximontana (F. saximontana abundant 0-100, Oryzopsis exigu 5, 50, Agropyron [Elymus="Sitanion"] longifolius 30, 45, etc., Danthonia parryi 90, Bromus tectorum 25, Stipa comata 45, 50, Koeleria macrantha 40, 1/2 m tall grass 35, 50-100); egg found 12:37 on Festuca saximontana (F. saximontana 5, 15, 20, 30, 60-70, 90, Stipa comata 12, 15, 25-30, etc., Bouteloua gracilis 30-50, Agropyron trachycaulum 80, Agropyron [Elymus="Sitanion"] longifolius 20, 80, Agropyron [P.] smithii 50, 80, Oryzopsis exigu 60-100); egg found 12:51 on Festuca saximontana (F. saximontana 5, 20-25, 40-50, 70-80, Agropyron [Elymus="Sitanion"] longifolius 20-30, 80, Koeleria macrantha 50, 70, 80-100, Danthonia parryi 20, 70-100, Oryzopsis exigu 20-50, 80-100, Stipa comata 70, Carex probably pensylvanica heliophila 5, 15, 25-30, Poa ?pratensis 60-70); egg found 13:00 on Festuca saximontana (F. saximontana 10-15, Danthonia parryi 20-100, Stipa comata 60, Agropyron [Elymus="Sitanion"] longifolius 20, 25, 40, Koeleria macrantha 45-50, Bromus [Bromopsis] inermis 50, Bromus tectorum 70-100, Poa pratensis 40-100, Oryzopsis exigu 30-40, 30-60, 80-100, Carex probably pensylvanica heliophila 20, 80); egg found 13:05 on Festuca saximontana (F. saximontana none near, Carex probably pensylvanica heliophila common 20-100, Danthonia parryi 40-100, Oryzopsis exigu 30-100, Poa nemoralis interior 25, Poa pratensis 50-100, Bromus tectorum 20-100, Bromus [Bromopsis] inermis 15); egg

found 13:24 on Festuca saximontana (F. saximontana 8, 25, 25, 50, Agropyron [P.] smithii 20, 45, 50, Bromus tectorum scattered 10 cm onward, Poa nemoralis interior 8, 10, common 20-100, Koeleria macrantha 45, Stipa comata 45, Bouteloua gracilis 20-30, 50-100); egg found 13:34 on Koeleria macrantha (K. macrantha none near, Festuca saximontana 30, 35, 35, 40, 60, Stipa comata 20, 35, 50, 70, 70, Bouteloua gracilis 10-100, 20-100, Agropyron [Elymus="Sitanion"] longifolius 20, 20, Bromus tectorum 10-100, Poa pratensis 90-150, Carex probably pensylvanica heliophila 4, 15, 25, 40, 30-100); egg found 13:56 on Festuca saximontana (F. saximontana 20, Agropyron [P.] smithii 15, 25, 35, abundant 35-100, Koeleria macrantha 10-20, abundant 20-100, Poa nemoralis interior 40, Oryzopsis exiguua 60-70, Stipa comata 15); egg found 14:00 on Koeleria macrantha (K. macrantha 0-20, 50, 70, abundant 30-100, Oryzopsis exiguua 10-20, 30-100, Stipa comata 30, 35, 50-70, etc., Agropyron [P.] smithii 60, 70-100, Festuca saximontana 5, 10, 15, 15, common 20 cm onward, Bromus tectorum scattered 30 cm onward); egg found 14:33 on Festuca saximontana (F. saximontana 8-10, common 30 cm onward, Oryzopsis exiguua 80-100, Agropyron [P.] smithii 20, 30, 40, 50-100, Bromus [Bromopsis] inermis 40, 40, 40, Koeleria macrantha 70-90, Bromus tectorum scattered 35 cm onward, Stipa comata 15, Agropyron [Elymus="Sitanion"] longifolius 40, 45, 70); egg found 14:46 on Festuca saximontana (F. saximontana 10, 20, 20, 25, 40, 45, Koeleria macrantha 20, 45, Bromus tectorum abundant 10-100, Stipa comata 65, Agropyron [Elymus="Sitanion"] longifolius 40-50, 60-65, etc.); egg found 15:04 on Festuca saximontana (F. saximontana 10-20, 30, Bouteloua gracilis 30, Danthonia parryi 40-80, Carex probably pensylvanica heliophila 80-100, Oryzopsis exiguua 100, Agropyron [Elymus="Sitanion"] longifolius 35, 65-100, Bromus tectorum 16, Koeleria macrantha 90); egg found 15:22 on Festuca saximontana (F. saximontana 7, 15, 20, 20, 25, 30, etc., Carex probably pensylvanica heliophila 20-25, 30-100, Koeleria macrantha 50, Agropyron [Elymus="Sitanion"] longifolius 30, 30-35, 40, Oryzopsis exiguua 40-100); Guy Hill, Jefferson Co. Colo., June 20, 1989. HOSTPLANTS: 148 eggs or ovipositions were found. Guy Hill is a low montane grassland hillside where H. nevada is common, H. comma is common but flies much later than H. nevada, H. pahaska is less common but flies mostly later than H. nevada, and H. uncas and H. juba are rare. Ovipositing females hover slowly as usual, but if they encounter a tree or shrub or shade or a patch of unsuitable habitat or a disturbance they shift into high speed; as a result they can be followed to oviposition less than 50% of the time, so only 4 ovipositions were seen. Females obviously prefer to oviposit in areas with some bare ground, on the outside (underside) of leaves about 2 cm above ground, on or near the outside of 2-3 cm wide tender young grass clumps (mostly of Festuca saximontana, sometimes Koeleria macrantha or Stipa comata); very few eggs were laid on dicotyledons. Eggs were common around several pine trees at Guy Hill, but not around others so this was apparently coincidence. Koeleria macrantha was searched somewhat more often than its abundance in the grassland would have warranted if searching had been random in 1988, but was searched much less than random search would require in 1989, so its popularity for oviposition is probably a bit more than the egg count in Table 7 would suggest. The grassland here has millions of grass individuals, so the observer might think that it would be very difficult to find H. nevada eggs; however, after discovering their preferred hosts, I found that it takes only a few minutes to find an egg by searching the favorites Festuca saximontana and Koeleria macrantha. Festuca saximontana is the favorite (97 eggs), Koeleria macrantha is second (28 eggs including 1 on Solidago under it), and Stipa comata is third (16 eggs, plus 1 egg that could be on misidentified Koeleria macrantha, plus 1 egg on Aster ericoides near S. comata and Poa pratensis); females rarely lay on other grasses (Bouteloua gracilis 4 eggs, Poa pratensis 1 egg, Danthonia parryi 1 egg, Oryzopsis exiguua 1 egg, non-monocot 1 egg). Stipa comata is very common but has few eggs; its leaves are narrow and usually so tough that I prefer to believe that it is a poor host for all butterflies. Bouteloua gracilis, Oryzopsis exiguua, Agropyrum (Pascopyrum) smithii, Danthonia parryi, Poa pratensis, and Carex probably pensylvanica heliophila have few or no eggs despite extensive search. The following discusses the various grasses at this site and their appeal for H. nevada (the grasses are listed from most succulent in appearance to least succulent): Poa pratensis is lush, but is rarely chosen; Danthonia parryi is also a lush green wide-leaf grass growing in large clumps, but for some unknown reason is shunned by all butterflies. Carex probably pensylvanica heliophila is common and green and grows in clumps, but is shunned. Koeleria macrantha leaves are dark green and very succulent when touched, so it would appear to be a great host, but it is only second choice by the skippers (the taxonomy of this plant is unresolved, and most people who see it in nature including myself think that there must be several species involved, the plants are so variable). Oryzopsis exiguua looks like a terrific hostplant because the

grayish-green leaves are somewhat tender and it grows in a large clump 10-20 cm wide; however it is nearly universally shunned by all butterflies. Bouteloua gracilis grows in nice clumps and stays somewhat green even in a drought, but is mostly ignored. Festuca saximontana is a small grass, only ~4 cm tall and ~3 cm wide, with blue-gray leaves, but is the favorite host. Festuca arizonica grows in a very large inviting clump 20 cm wide, but has hairlike grayish leaves and is also universally nearly shunned. Stipa comata grows in clumps and is very common but has very tough narrow gray leaves and is mostly ignored by all or most butterflies. Agropyrum (Pascopyrum) smithii and Agropyron (Elymus="Sitanion") longifolius also have tough leaves, the former bluish-gray, and are ignored. Bromus tectorum is an annual grass, dead and brown this time of year, so is shunned. Vulpia octoflora is a tiny green annual grass, which looks somewhat tough and is shunned. The essential conclusion of this discussion is that H. nevada does not choose its hosts according to my succulence rating, or according to the size of the grass clumps, it evidently chooses its favorite hosts according to some biochemical odor. When the results from Guy Hill and South Park (see below) are combined, the favorite hosts (Festuca saximontana and Festuca idahoensis) differ greatly (a very small clump with 1 mm x 4 cm leaves versus a large clump with <1 mm x 20 cm hairlike leaves), which seems to confirm the conclusion that biochemical factors guide host choice. EARLY STAGES: Mature or nearly mature larvae must hibernate usually; lab larvae did not diapause and continued feeding, and consumed Poa pratensis, though disease eventually killed all but one larva, which pupated. EGG cream, versus green in Polites draco; hemispherical, larger than P. draco eggs. FIRST-STAGE LARVA yellowish-cream (slightly greenish internally after feeding), seta D1 on A10 fairly long, nearly as long as the longest seta, which is D2 (D1 is longer than shown by MacNeill 1964 Fig. 5) (H. pahaska & H. uncas have D1 on A10 very long, longer than nevada) (all 1988 and most 1989 eggs were allowed to hatch and the resulting larvae examined with a microscope for these traits); collar dark brown; head chitin-brown. HALF-GROWN LARVA medium-brown. MATURE LARVA dark brown, collar black with a black satellite sclerite just above spiracle; head black, with a long medium-brown stripe along coronal sulcus and a shorter medium-brown stripe along upper part of adfrontal sulcus. PUPA head, thorax, & wings dark blackish-brown, wings dark blackish-gray, abdomen light brown with dark-brown transverse dashes (several strong dashes above and just in front of spiracle axis, weaker ones posteriorly and below and behind spiracle axis), A9 dark-brown, medial part of eye & orbit ochre & hairy, posterior base of eye ochre (appearing to be a separate sclerite), some tufts of long ochre setae on head (each tuft is on an ochre area), T1 spiracle ochre, an ochre streak on each side of T1; a tuft of setae & a lenticle cluster lateral to proboscis on A5 & A6, abdomen has many short ochre setae; hind legs extend 1.7 mm beyond wings, proboscis extends 5 mm beyond wings; cremaster sharp, with lateral hairs and terminal crochets; pupated upside-down attached by cremaster (no silk girdle) in nest of silked-together leaves, the silk had lots of "lumpy" areas in it.

Hesperia nevada nevada (Scud.). (Adults have greenish-ochre-brown ventral hindwing, as in most of the species' range.) Oviposition Koeleria macrantha (W), 2 mi. NE Rosita, Custer Co. Colo., June 30, 1969. Egg (#80) found on Festuca idahoensis large clump (F. idahoensis 10, 20, 20, 40, etc., Koeleria macrantha 5-40, Bouteloua [Chondrosium] gracilis 15-1 m, Muhlenbergia torreyi 10-1 m); egg (#81) found on Festuca idahoensis large clump (F. idahoensis 15, 15-40, 40-1 m, Koeleria macrantha 15, Muhlenbergia torreyi 3, 3-1 m, Bouteloua gracilis 15-1 m); egg (#83) found on Festuca idahoensis large clump (F. idahoensis 20, 20, 25, etc. to 1 m, Koeleria macrantha 3-10, 60, Stipa comata 5-20, Muhlenbergia torreyi 15-1 m, Carex oreocharis 40-1 m); egg (#84) found on Festuca idahoensis large clump (no F. idahoensis nearby, Bouteloua gracilis 5-25, Carex oreocharis 3-1 m common, Muhlenbergia torreyi 40-1 m, Agropyron [Elymus="Sitanion"] longifolius 50); egg (#86) found on Festuca idahoensis large clump (F. idahoensis 0-30, 40, 50, 1 m, Muhlenbergia torreyi 10-1 m, Koeleria macrantha 25, 45); egg (#88) found on Festuca idahoensis large clump (F. idahoensis 10, 15, 20, 40, 1 m, Koeleria macrantha 25 etc. onward, Carex oreocharis 10 onward, Muhlenbergia torreyi 10 common); egg (#90) found on Koeleria macrantha (K. macrantha 15, Bouteloua gracilis 1 cm-1 m, Muhlenbergia torreyi 20-1 m, Carex oreocharis 35, 50); egg (#91) found on Festuca idahoensis large clump (F. idahoensis 10, 1 m, Koeleria macrantha 5-15, 60, 60, Muhlenbergia torreyi 7-1 m, Carex oreocharis 8-1 m, Bouteloua gracilis 30, 30-90); all South Park SW Jefferson, Park Co. Colo., June 23, 1988. Egg found on Stipa comata (S. comata none nearby, Festuca idahoensis 20-40 cm, 30-100, 50-70, Festuca saximontana 90, Carex obtusata 90), NW Tabernash, Grand Co. Colo., June 24, 1989. Egg found on Festuca idahoensis (F. idahoensis none nearby, Agropyron

[*Elymus*, "*Elytrigia*"] *dasytachyum* 5, very abundant 30-200, *Stipa comata* 20, *Koeleria macrantha* 50-60), SW Hot Sulfur Springs, Grand Co. Colo., June 30, 1989. HOSTPLANTS: Eggs are laid 2-4 cm above ground on the lower surface of leaves. In South Park, *Bouteloua gracilis* was very common but searched very little, *Muhlenbergia torreyi* was very common and many were searched, *Festuca idahoensis* grew in scattered large clumps and most clumps were searched, *Koeleria macrantha* was uncommon but ~50 were searched, *Agropyron* (*Elymus* = "*Sitanion*") *longifolius* was fairly common and some searched, *Carex oreocharis* common but few searched, *Stipa comata* uncommon and very few searched. The main host in South Park is obviously *Festuca idahoensis* (7 eggs), the second choice *Koeleria macrantha* (1 egg). Thus the host preference is almost the same as in Jefferson County, except a different *Festuca* is chosen. Curiously, *Festuca idahoensis* resembles *Festuca arizonica* in Jefferson Co. (same hairlike leaves and large clumps) but *F. arizonica* is shunned in Jefferson Co. where the preferred *Festuca saximontana* is a tiny clump with wider gray leaves. This again seems to show that olfactory biochemical cues rather than visual appearance are used by ovipositing females to select hostplants.

Atalopedes campestris (Bdv.). Adults associated with *Poa pratensis* (the only grass in lawn), Morse Park, Lakewood, Jefferson Co. Colo., Aug. 12, 31, Oct 5, 1987. Adults associated with *P. pratensis* (the only grass in lawn), Kendrick Lake, Lakewood, Jefferson Co. Colo., Sept. 9, 1987. Larvae eat *P. pratensis* in lab. EARLY STAGES (egg larvae pupae from eggs laid by W Neb. female, larvae from Lakewood): EGG white, circular in dorsal view, lower edge slightly rounded, without flange. 1ST-STAGE LARVA cream; collar & head black. YOUNG LARVA (1/3 grown) dark-green (more tan beneath), middorsal band darker; collar & head black. HALF-GROWN LARVA light-brown (older larvae become darker and darker). MATURE LARVA dark brown (under microscope, actually cream with thousands of red-brown spots, one under each seta), ochre-brown laterally, middorsal line blackish-brown on A2-A10, ventral neck gland present, T1 spiracle black, collar and circular sclerite below it black (collar edged by white anteriorly); head black with a weak to strong gray streak along coronal sulcus, pale-brown adfrontal areas (absent sometimes), and an orangish spot in front of eyes (absent on some larvae). PUPA when first formed tan-cream on abdomen (orange-tan on top of abdomen, light-brown on top of thorax, tan on wings) with blackish mottling on head T1 and front of T2 and T3, heart-line brown on abdomen, numerous small brown dashes very similar to the spots of *Poanes* and *Hesperia* pupae; abdomen then becomes pinkish-tan and head thorax wings become dark gray-brown, finally abdomen becomes orange-brown and head thorax wings nearly black and the abdominal dots brown-black, head has a large ochre circular spot next to middorsal line and a similar spot on anterior medial front of head with a tiny ochre spot beside it, orbit and vicinity is ochre, cremaster brown, T1 spiracle pale brown, proboscis extends 1-1.5 mm beyond wings. Perhaps *Atalopedes* is a subgenus of *Hesperia*.

Polites. I have reared all 7 Colo. *Polites*, and the early stages of all other species (*baracoa*, *vibex*, *mardon*) are known (except for the *baracoa* pupa), so comparisons between species can be made. *P. peckius*, *mystic*, and *sonora* lay eggs without glue which fall to the litter; *draco* and *themistocles* often lay eggs on dicotyledons rather than hosts. Only *origenes* makes aerial larval nests. Some eggs are cream, others are pale greenish, and in some species the eggs turn orangish or pinkish. First-stage larvae are similar in all species; the body turns greener after feeding. Mature larvae are usually brown (but *sabuleti* is slightly greenish and *P. vibex* is pale green); all have the heartline darker. The top of A10 of older larvae is unmarked brown in *mystic* & *sonora* & *origenes*, whereas in *sabuleti* & *peckius* its rear rim is brown but a blackish UU-shaped mark occurs on A10, while in *draco* & *themistocles* & *mardon* (and perhaps *baracoa* and *vibex*?) the A10 rear rim is blackish and a subdorsal and middorsal blackish band is on A10. The mature larva head is solid black (except "dull yellow" in *baracoa*) without pattern in *draco* & *mystic* & *sonora* & *origenes*, but in the apparent ancestral type in *sabuleti* & *mardon* & *peckius* & *themistocles* & *baracoa* & *vibex* the head has paler stripes (generally beside coronal sulcus, in adfrontal area, & a spot in front of eyes). Pupae are mostly dark brown, though *mystic* & *sonora* pupae are more black, and *sabuleti* & *themistocles* are greenish. The pupal proboscis extends 4-7 mm beyond wings to cremaster in most species, but extends only 2-2.5 mm beyond wings in *sabuleti* & *themistocles* (*baracoa* & *mardon* proboscis unknown). I have not yet examined first-stage larval setae, but now *draco* seems to be an offshoot of *sabuleti* as may be *mardon*, *mystic* and *sonora* are closely related and evolved from the precursor of *peckius*, while *origenes* and the closely-related *themistocles*/*baracoa* form a branch that evolved from the precursor of *sabuleti*; *sabuleti* and *peckius* may occupy the middle of a probable phylogenetic network

with vibex nearby. Perhaps Polites is just a subgenus of Hesperia; the only difference currently separating them is that the antenna club is a bit longer in Polites; the variation within the early stages of Polites seem to encompass Hesperia.

Polites draco. Female preovipositions 10:09, 10:25, 10:30, Poa pratensis (common nearby); oviposition 10:20 on underside of leaf of 4 cm Potentilla? beside Poa pratensis (P. pratensis common nearby, Stipa comata 3 cm away and common also, Danthonia parryi rare 20 cm away, Koeleria macrantha rare 30 cm away, Bromus [Bromopsis] inermis rare 70 cm); oviposition 12:14 on underside of Poa pratensis leaf next to Agoseris aurantiaca (P. pratensis common nearby, Stipa comata 10 cm uncommon, Bromus (Anisantha) tectorum 1 old stalk 20 cm and common 40-70 cm, Koeleria macrantha rare 90 cm, Bromus [Bromopsis] inermis uncommon 20, 1 m); preoviposition 12:10 bent abdomen in litter under Astragalus sp. (Poa agassizensis common all around); all Guy Hill, Jefferson Co. Colo., June 13, 1988. Oviposition 9:57 on top of Antennaria parvifolia leaf (Poa nemoralis interior common 10, 15, 20, 30, 50 cm onward, Stipa comata common 8-20 cm, 30, 40, 80, 100 cm away, Bouteloua (Chondrosum) gracilis 40 cm away, Danthonia parryi 70 cm, dead Festuca saximontana 70 cm away, old Bromus tectorum 20, 40 cm, common 70 cm); preoviposition 10:27 on underside of Taraxacum officinale leaf (Carex probably pennsylvanica heliophila, Bouteloua gracilis, Stipa comata within 10 cm, Poa pratensis 25-100 cm); preoviposition 10:53 bent abdomen on underside of Solidago leaf (Poa pratensis all over, Bouteloua gracilis 10-100 cm); oviposition 11:01 on underside of Poa pratensis leaf (P. pratensis common all over, Danthonia parryi clump 8-30 cm, Bouteloua gracilis rare 10 cm); all Guy Hill, Jefferson Co. Colo., June 14, 1988. Oviposition 13:40 on underside of Antennaria parvifolia leaf (Poa pratensis thick all over and near egg, Stipa comata 2, 20, 40, 70, 90 cm away, Agropyrum [Pascopyrum] smithii 20, 30, 30 cm away, Koeleria macrantha 1 m away), Guy Hill, Jefferson Co. Colo., June 15, 1988. Egg found on underside of Oxytropis lambertii Pursh seedling leaf beside Koeleria macrantha (K. macrantha common 1-100 cm away, Poa pratensis 3, 15 cm away common and thick all around, old Bromus tectorum scattered 20-100 cm, Agropyrum [Pascopyrum] smithii 10, 10-20, 50, 80, 90 cm, Agropyron [Elymus="Sitanion"] longifolius dead inflorescence 50 cm, Bouteloua gracilis 40-80, 90-120 cm, Carex probably pennsylvanica heliophila 1 m, Danthonia parryi 40-50 cm), Guy Hill, Jefferson Co. Colo., June 16, 1988. Oviposition 10:22 Koeleria macrantha stem (K. macrantha 12, 15, 20, 30, 40, 40, 50 cm, Poa pratensis also in small oviposition clump and thick 0.5 cm onward, Stipa comata 5, 20, 30, 40-50 cm etc.); egg found (#10) Festuca saximontana (F. saximontana 5, 15-20, 20-40 cm onward, Koeleria macrantha 2, 20, 20, 1 m, Oryzopsis exiqua 15-40, 90-1 m, Agropyrum [Pascopyrum] smithii common 20-100 cm, Bouteloua gracilis 30, 50 cm); both Guy Hill, Jefferson Co. Colo., June 17, 1988. 1 egg found (#22) on underside of Koeleria macrantha leaf (K. macrantha 1-5, 15, 20, 25, 25, 30, 40 cm, etc., Festuca saximontana 4, 20, 20-25, 25, 30, 60 cm, etc., Oryzopsis exiqua 40-50, Bouteloua gracilis 5-10, 6, 10, 20, 50, 60 cm, Stipa comata 5, 8, 10, 15, 15, 20 cm onward, Danthonia parryi 50-65 onward); 1 egg found (#23) on Festuca arizonica clump (no other clumps of Festuca arizonica, Carex probably pennsylvanica heliophila 5, 8, common 20 onward, Koeleria macrantha 10, 10-15, 25, 30 cm, etc. common, Bouteloua gracilis 15 cm uncommon, Danthonia parryi 40, 60, 60, 70, 70 cm, Festuca saximontana 12, 40, 60, 70 cm, Stipa comata 20 cm, Oryzopsis exiqua 70 etc.); both Guy Hill, Jefferson Co. Colo., June 19, 1988. Preoviposition 11:35 bent abdomen toward Festuca saximontana twice, Stipa comata once, Koeleria macrantha once, she did not land on Poa pratensis; egg found on (#64) Koeleria macrantha (K. macrantha 12, 20, 50-80 cm, Bouteloua gracilis 5-100 cm, Poa compressa 25-60 cm, old Bromus tectorum 5 cm common, Stipa comata 10, 15-30 cm common, Danthonia parryi 30, 40 cm, Agropyrum [Pascopyrum] smithii 50 cm); both Guy Hill, Jefferson Co. Colo., June 20, 1988. Egg (#71) found on Festuca arizonica giant clump (F. arizonica another small clump 15 cm, Danthonia parryi 12-100 cm, Festuca saximontana 20, 100 cm, Poa pratensis 40-100 cm, Stipa comata 40, 40, 45, 70, 70, 70, 70 cm, Agropyron [Elymus="Sitanion"] longifolius 25, 30, 90 cm, Koeleria macrantha 1 m), Guy Hill, Jefferson Co. Colo., June 21, 1988. Oviposition (#92) 10:43 Agropyron (Elymus="Sitanion") longifolius young leaf (A. [E.] longifolius 40, 90 cm, 1 m, 1m, Poa pratensis 20, 40-1 m, 40-1 m [commonest grass over a several meter areal, Bouteloua gracilis 5-1 m, Stipa comata 10, 18, 20, 20, 20, 25, 30 cm onward, old Bromus japonicus 3, 15, 40, 45 cm, old Bromus tectorum 10-1 m common); egg (#100) found on Koeleria macrantha (K. macrantha 20-30, 30, 50, 80 cm, Agropyron [Elymus="Sitanion"] longifolius 20, 80, 80 cm, Stipa comata 15, 15, 20, 20 cm etc. common, Poa pratensis 20, 35, 50-1 m, Carex probably pennsylvanica heliophila 7, 7, 10, 10-1 m); both Guy Hill, Jefferson Co. Colo., June 27, 1988. Preoviposition 9:20-9:23, female bent abdomen 3 times on Poa

Pratensis; oviposition 9:24 under Poa agassizensis leaf (P. agassizensis abundant 0-5 m in large sward, Agropyron [Elymus="Sitanion"] longifolius frequent 10-90 cm, Stipa comata frequent 15-60 cm); egg found on Festuca saximontana (F. saximontana 5, 5, 15, 20, 30, 40, 80-90 cm away, Koeleria macrantha 60, Agropyron [Pascopyrum] smithii 10, very common 15-100, Agropyron [Elymus="Sitanion"] longifolius 10, 20, 30 etc. common, Stipa comata 20, 45, Bouteloua gracilis 5-40, Oryzopsis exiguua 35-90), Guy Hill, Jefferson Co. Colo., June 19, 1989. Egg found 9:28 on Festuca saximontana (F. saximontana 25, 45-70, Carex probably pennsylvanica heliophila 2, 10, 20-100, Danthonia parryi common 10-100, Koeleria macrantha 5, 40, 90, Agropyron [P.] smithii 45, 100, Oryzopsis exiguua 30-45, Bromus tectorum 50-100, Stipa comata 90); egg found 14:40 on Festuca saximontana (Festuca saximontana 15, 20-30, 25, 60, 70, etc., Bromus tectorum abundant 5-100, Oryzopsis exiguua 60, 100, Agropyron [P.] smithii 15-20, 40, 55, Stipa comata 20, 25, 40); Guy Hill, Jefferson Co. Colo., June 20, 1989. Egg found 14:34 on Koeleria macrantha (K. macrantha 30, 30, Agropyron [Elymus, "Elytrigia"] dasystachyum 15, 30, 60, small "Stipa" 50, 60, 60, Festuca idahoensis 17, 20, 25, common to 100); egg found 13:19 on Festuca idahoensis (F. idahoensis 20, 20, common 25-100, Stipa comata 5, 5, common 15-100); SW Hot Sulfur Springs, Grand Co. Colo., June 28, 1989. Oviposition 12:25 on side of Lupinus prunophilus peduncle 8 cm above ground after first landing on Festuca idahoensis (F. idahoensis 8, 8, 15, 20, 20, 25, 30, etc. abundant, Stipa comata 5, 35, 50, 50, 90 common, Carex sp. 3, 35, Koeleria macrantha 5); egg found 9:35 on Festuca idahoensis (Festuca idahoensis 35, 40, 40, 60, 70, 80-120, Stipa comata abundant 5-100, Carex sp. 22-30, 30, 30, 40 etc.); SW Hot Sulfur Springs, Grand Co. Colo., June 30, 1989. Preoviposition 12:30 she bent abdomen on 10-cm-tall dicot near Festuca idahoensis; SSW Hot Sulfur Springs, Grand Co. Colo., July 4, 1990. HOSTPLANTS: Koeleria macrantha (6 eggs, including 1 egg on Oxytropis beside K. macrantha), Festuca saximontana (4 eggs), Poa pratensis (4 eggs, including 1 egg on Potentilla beside P. pratensis and 1 egg on Antennaria leaf near P. pratensis), Festuca idahoensis (3 eggs, including 1 laid on Lupinus prunophilus peduncle beside F. idahoensis), and Festuca arizonica (2 eggs) are favorites; occasional hosts are Poa agassizensis (1 egg), Poa nemoralis interior or Stipa comata (1 egg on Antennaria near them), Agropyron (Elymus) longifolius (1 egg). Adults associated with Poa pratensis, Crawford Gulch, Jefferson Co. Colo., June 10, 14, 1992. P. draco evidently oviposits on a variety of grasses, including small bunchgrasses and turfgrasses, especially lush green grasses and Festuca (which has leaves that are narrow but tender); A. (E.) longifolius is a tough grass, possibly a "mistake" by the female. Larvae were reared to pupae on Poa pratensis. P. draco oviposits on underside of dicotyledon leaves near hostplants about half the time (4 of 9 ovipositions, or 44%—dicotyledons were not searched for eggs, so the eggs found by searching were nearly all on grasses, and the 1 egg found on a dicotyledon was merely luck), versus most of the time for P. themistocles. Larvae make the usual silked-leaf tube nest, which in nature must be at the plant base/litter/soil. Larvae must hibernate 2/3 grown (the unfed 4th stage most likely) in nature; they did not diapause in lab. Early stages (Guy Hill): Egg very pale green, without color change, turning cream and black only when the larva becomes visible within (Polites themistocles eggs develop spots; Hesperia eggs are larger and cream when laid). FIRST-STAGE LARVA cream when first hatched, later covered with hundreds of tiny brown spots giving the body a tan appearance; collar and head brownish-black. SECOND-STAGE LARVA brown with many more setae; head black. OLDER LARVAE uniform dark brown, a middorsal blackish-brown band (weak on thorax), a faint dorsolateral (40% of way from spiracles to middorsal band) blackish-brown band, rear rim of A10 black connected to subdorsal and middorsal black band on A10; collar and head black. PUPA thorax brown, abdomen ochre, a middorsal abdominal brown band (consisting of a longitudinal dash on A1 and A6, A7, A8, an oval on A2 and A3, two parallel dashes on A4 and A5), a faint lateral band of brown dashes containing spiracles, a brown dash under each spiracle on A4-6, a brown lateroventral spot under the front of each of these dashes on A4-6, a patch of setae lateral to proboscis on A4, A5, A6, A7, proboscis reddish-brown where it extends 4.5 mm beyond wingtip to base of cremaster, after 1 day pupa covered by bluish-white waxy bloom, abdomen, head, & top of thorax covered with short ochre hair. Early stages differ somewhat from those of Polites sabuleti (larval head lacks pale markings, pupal proboscis longer, larva-pupa browner, A10 blackish on rear rim), which supports the idea that P. draco is a distinct species from P. sabuleti; also, the "intermediates" between draco and sabuleti reported earlier (Scott 1986b p. 443) from Grand Mesa, Mesa Co. Colo. proved on further examination to be just P. sabuleti sabuleti.

Polites sabuleti sabuleti (Bdv.). Crunchgrass Skipper. Adults associated with Distichlis spicata var. stricta (C) and Sporobolus airoides, at 1 mi. W

Kingston, Piute Co. Utah, Aug. 11, 1974. Adults associated with D. s. var. stricta (C) at Green River, Emery Co. Utah, Aug. 23, 1974, and at Barr Lake, Adams Co. Colo., Aug. 29, 1984–Sept. 12, 1988, and at 1 mi. NW Brighton, Weld Co. Colo., Sept. 2, 1984. D. s. var. stricta is the usual host in the Great Basin, on alkali flats on valley bottoms. Adults assoc. with Poa sp. and other grasses in wet meadows at many sites in La Plata and Montezuma Cos. Colo. and San Juan and Santa Fe Cos. New Mex. Adults associated with Sporobolus airoides (previously misidentified by other botanists as Eragrostis trichodes) at 4 mi. NE Pilar, Rio Grande, Taos Co. New Mex., Sept. 10, 1977, and at .6 mi. E La Madera, Rio Arriba Co. New Mex., Sept. 10, 1977; despite having the same probable host as P. sabuleti ministigma, adults along the Rio Grande of N New Mex. are ssp. sabuleti. Oviposition 11:27 tiny Hordeum (Critesion) jubatum plant (H. jubatum very common and Distichlis spicata var. stricta less common nearby, Juncus compressus L. 0–30 cm, Juncus arcticus ater var. vallicola 20–1 m); preoviposition 11:26 Hordeum jubatum; oviposition 11:25 Poa arida (P. arida common nearby, Distichlis spicata var. stricta rare 80, Juncus arcticus ater var. vallicola 5–1 m common, Hordeum jubatum 50–1 m, Muhlenbergia asperifolia 30, 40 cm); all Barr Lake, Adams Co. Colo., Aug. 23, 1988. Oviposition 12:03 on underside of Puccinellia distans leaf (P. distans clump 17, 50 cm, uncommon, Juncus compressus 2, 4, common 10 cm, Hordeum jubatum 2, 10, 15, 60 cm, Distichlis spicata var. stricta 2, 4, 10, 12, 50, 70, 70 cm, Muhlenbergia asperifolia 10 cm); preoviposition 11:52 Juncus compressus (J. compressus very common nearby, Hordeum jubatum common, Distichlis spicata var. stricta only 2 tiny plants there); oviposition 12:36 on underside of Juncus compressus leaf (J. compressus common 0–1 m, Hordeum jubatum 1, 25, 40 cm, Distichlis spicata var. stricta 3, 5, 6, 7, 10, 20 cm onward, Puccinellia distans 10, 20, 50, 90 cm, 1 m); all Barr Lake, Adams Co. Colo., Aug. 27, 1988. Preovipositions 11:16 Juncus compressus; preoviposition 11:42 Juncus compressus (J. compressus common nearby, Hordeum jubatum there, Distichlis spicata var. stricta 2 cm away); oviposition 12:10 one egg on Distichlis spicata var. stricta, another egg found 1 cm away on Juncus compressus (D. spicata var. stricta, J. compressus, and Hordeum jubatum were all common beside eggs and up to 10 cm onward, Muhlenbergia asperifolia 1 m); preovipositions 12:13, 12:15, 12:23, 12:39, 13:07, all near both Distichlis spicata var. stricta & Juncus compressus; preoviposition 12:18 Distichlis spicata var. stricta & Hordeum jubatum; oviposition 12:20 on dead Juncus compressus sheath (J. compressus thick there and all over, Distichlis spicata var. stricta also beside and near egg); oviposition 12:23 (2 eggs within 1–2 cm) on Distichlis spicata var. stricta (D. spicata var. stricta common nearby also, Juncus compressus present there and all over, only 1 Hordeum jubatum plant was within ~6 cm away); oviposition 12:40 on Juncus compressus (J. compressus common 0–1 m, Hordeum jubatum tiny plant within 1 cm and 3 others within 5 cm, Distichlis spicata var. stricta common within 5 cm, Puccinellia distans 1 plant within 5 cm, another 1 m, Muhlenbergia asperifolia 20, 50 cm); preoviposition 12:41 Puccinellia distans (P. distans common, Juncus compressus common, Distichlis spicata var. stricta only 2 small plants nearby); oviposition 12:56 2 eggs near each other on Juncus compressus (J. compressus common 0–1 m, Distichlis spicata var. stricta next to eggs and common nearby, tall sedge 15, 20, 90 cm, Hordeum jubatum 1 m); oviposition 13:05 on Juncus compressus green leaf (J. compressus thick 0–1 m, Hordeum jubatum common next to egg and others within ~6 cm, Distichlis spicata var. stricta 1 plant next to egg and common within ~6 cm, Puccinellia distans 80); oviposition 13:10 on green Juncus compressus leaf (J. compressus thick 0–1 m, Hordeum jubatum common next to egg and within ~6 cm, Distichlis spicata var. stricta common within ~6 cm, Scirpus americanus? ("Schoenoplectus pungens") 5, 10, 15, 25, 30 cm); oviposition 13:27 on dead Juncus compressus leaf and an egg about to hatch found very near on Hordeum jubatum plant (Juncus compressus common 0–1 m, Hordeum jubatum plant next to first egg and 4 plants within ~6 cm, Distichlis spicata var. stricta 2 plants next to eggs and common within ~6 cm); all Barr Lake, Adams Co. Colo., Sept. 6, 1988. HOSTPLANTS: At Barr Lake Distichlis spicata var. stricta and Hordeum jubatum are both major hosts (both have very similar leaves, and plants without inflorescence can be distinguished only by microscopic differences of leaf surfaces); Poa arida and Puccinellia distans are occasional hosts. (By association D. s. var. stricta and Sporobolus airoides are hosts elsewhere). The hostplants are "crunchgrasses"—low grasses of semialkaline places that must be rather dry because when they are stepped on they "crunch"; the common name of the butterfly should be "Crunchgrass Skipper." Juncus compressus is the commonest monocot and a frequent oviposition substrate at the Barr Lake meadows, but 1st-stage larvae would not eat this (not even one bite) in a two-day lab trial so it is not a host (and I know of no butterfly that eats Juncaceae). In the lab, larvae (from eggs laid by females from Barr Lake, Adams Co., Colo.,

Aug. 30, 1987) were reared to pupae on Poa pratensis. Females all oviposited in spots (typically ~ 0.5 m wide) where cows have grazed the grass/sedge/rush plants down to only ~4 cm height; they never oviposited or even landed on the 10-20 cm tall mature clumps. The explanation is probably that females seek the younger more tender plants that are exposed in grazed spots (and grazing may stimulate the growth of young grass shoots). This explains why P. sabuleti is common on lawns in Calif. and W-C Colo.; perhaps it has not invaded the Poa pratensis lawns in Denver because it prefers drier grasses, such as Cynodon dactylon, the Calif. urban host. Barr Lake has three meadows where P. sabuleti occurs, all three with moist-meadow centers (too moist for sabuleti) where Distichlis spicata var. stricta & Hordeum jubatum are on the drier edge of the meadows; P. sabuleti is uncommon in a small meadow without cows, more common in a small meadow with cows, and commonest in a large meadow with cows. So grazing may improve the habitat for sabuleti, and certainly does not hurt it. There are two flights in Adams Co. Colo. (E June and L Aug.-E Sep.) and apparently in W Colo.-N New Mex.-Utah-C Nev. Larvae must hibernate about half grown. Early stages (Barr Lake): EGG pale greenish-cream (perhaps slightly bluish-greenish-cream), does not develop spots (turns creamy when about to hatch)(in contrast, P. themistocles eggs develop spots). FIRST STAGE LARVA cream; collar & head black. MATURE LARVA greenish-light-brown in most larvae, brownish-green in others, numerous dark hairs, a middorsal brown band (this band on A10 blackish and consisting of several spots, and a subdorsal blackish band also occurs on A10), a very slight subdorsal dark dashlike patch on front of each abdomen segment, each abdomen segment has a lateral ridge the same color as body, a middorsally-divided black collar, A10 top has dark brown just in front of rear (some larvae have a subdorsal and an interrupted middorsal black bands on top of A10 while in others these bands are broken into small anterior and posterior blackish spots, and in other larvae these spots are small so that there is little trace of the subdorsal and middorsal band on A10), T1 spiracle black; head black with a vertical cream stripe near midline above an adfrontal cream stripe, a cream curve in front of eyes. PUPA head-thorax-wings brownish-green, abdomen greenish-yellow tinged with brown and covered with 1-mm red-brown hair (the front of each abdomen segment cream, the rear greenish-cream, posterior rim red-brown), a few clusters of red-brown hair on head, a middorsal band of brown spots (each spot narrowed on front of each segment) on abdomen, weak lateral and subventral brown areas on abdomen, T1 spiracle dark-red, cremaster light-red-brown, proboscis red-brown where it extends 2 mm beyond wings.

Polites sabuleti ministigma Scott. 11 eggs found on Sporobolus airoides (previously misidentified as Eragrostis trichodes [B]), 1 egg found on Equisetum sp., 1 egg found on unknown dicotyledon, all near S. airoides, NE of Hayden Creek Cgd., Fremont Co. Colo., July 10, 1971. Adults also associated with S. airoides in the San Luis Valley, Saguache Co., Colo. S. airoides is a tough dry grass whose leaves closely resemble those of Distichlis spicata and Hordeum (Critesion) jubatum (all three grasses "crunch" when stepped on), so clearly P. sabuleti is adapted to tough dry turflike crunchgrass. Only one flight in the San Luis Valley and Arkansas River Canyon. Half-grown larvae must hibernate.

Polites sabuleti chusca (Edw.). Adults associated with Distichlis spicata var. stricta, Mesquite, Clark Co. Nev., Aug. 8, 1974. Ssp. chusca must have 2-3 flights/year.

Polites peckius (Kirby). Ovipositions 11:30, 11:35 abdomen bent to underside of Distichlis spicata (W) var. stricta leaves, the eggs dropped from abdomen into litter (other grasses within 1/3 m of eggs were Agrostis gigantea [W] common, Hordeum (Critesion) jubatum [W] fairly common, Muhlenbergia asperifolia [W] rare), Barr Lake, Adams Co. Colo., Aug. 19, 1986. Adults associated with Poa pratensis (only grass present in lawn); Morse Park, Jefferson Co. Colo., Aug. 12, Oct 5, 1987, and park in Lakewood, Jefferson Co. Colo., Aug. 20, 1990. Female 13:00 landed on vertical Bromus (Bromopsis) inermis leaf and bent abdomen to leaf then flew rapidly away, no egg seen or found; adults were common in this B. inermis/Poa pratensis meadow, so presumably one of them is probably a host, but considerable time spent watching adults produced no ovipositions, and no eggs were found on these grasses (evidently because females let eggs drop from the abdomen as do Polites sonora and P. mystic); Wheatridge, Jefferson Co. Colo., Aug. 4-23, 1990, Aug. 17-Sept. 7, 1991. Hostplants: D. s. var. stricta, P. pratensis, and probably B. inermis are evidently hosts; Leersia oryzoides (a N.Y. host reported by A. Shapiro) cannot be more than an occasional host because it generally grows in/beside water and females lay eggs without glue so most eggs laid on it would float away. Larvae must make silk tunnels in litter/soil, because adults are found on Poa pratensis lawns where no aerial nests occur (and would be chopped off by lawn mowers if they did). Half-grown larvae must hibernate. EARLY STAGES (from eggs laid by female from Wheatridge, Jefferson

144 Co. Colo., Aug. 27, 1991): EGG cream when laid, becoming tan-conical, quite rounded on lower edge, laid without glue so all 20 eggs fell to bottom of lab container. 1ST-STAGE LARVA cream when hatched, neck & A10 slightly purplish, later (& 2nd-stage) becoming tan (a slight greenish tinge due to food in crop); collar & head black. OLDER & MATURE LARVA dark-brown (the thorax more slate-brown, the abdomen more orange-brown), a blackish heart-line from T3 rearward, A10 top has two black U's side-by-side (the adjacent arms joined into one making three arms total, forming 2 subdorsal and 1 middorsal band) the open ends facing anteriorly, collar black (narrowly edged anteriorly by tan); head black, a brown stripe along coronal sulcus, adfrontal area brown, a brown crescent in front of eyes. PUPA (most pupated Oct. 12-13 in lab) brownish-black, 2 bluish-gray spots on vertex, wings legs & mouthparts bluish-gray on black (except basal 1 mm of proboscis, and male stigma is black), a bluish line runs down antenna shaft then bluish-gray covers all of distal 2/3 of antenna, distal wing margin light brown, movable intersegmental areas (between A4-7) light-brown, T1 spiracle light-brown, tan hairs all over except on wings mouthparts & legs, proboscis extends 5 mm beyond wings to base or tip of cremaster. Perhaps P. peckius is more closely related to P. mystic and P. sonora than to P. sabuleti, because in all three species the eggs are laid without glue and the pupae are blackish and the proboscis is longer (only P. sabuleti and P. themistocles have a proboscis shorter than the cremaster); however the larval heads have pale markings in sabuleti (cream markings) and peckius (brown markings, thus intermediate between sabuleti and mystic) whereas mystic & sonora lack markings on larval head, and sabuleti and peckius resemble each other in wing pattern.

Polites mystic (Edw.). Oviposition 10:33 on Poa agassizensis (W) leaf (egg dropped into litter and was lost) in uniform sward of this plant, Corwina Park, Jefferson Co. Colo., July 3, 1986. Adults assoc. Poa pratensis, White Ranch Park, Jefferson Co. Colo., July 3, 1988. Oviposition 11:40, female landed on Agrostis gigantea stem (head upward, abdomen down) and a cream egg dropped down into litter (A. gigantea abundant nearby, Agropyron [Elytrigia] repens 20, Scirpus americanus [= "Schoenoplectus pungens"] uncommon 10-100, Juncus arcticus ater abundant nearby-100); oviposition 11:42, the same female flew 50 cm away and landed on stem (head up, abdomen down) of Juncus arcticus ater and dropped cream egg into litter (J. arcticus ater abundant nearby, Scirpus americanus uncommon 5-100, Agrostis gigantea 30-onward) (Agrostis gigantea is evidently the host for these two eggs); near Fort Collins, Larimer Co. Colo., July 9, 1989. Adults associated with Poa pratensis, Tinytown, Jefferson Co. Colo., June 16, 17, 1992. Oviposition 11:23, female landed on Equisetum and extruded abdomen and apparently dropped egg into litter but egg not found (Poa pratensis 2-100 cm away, Bromus [Bromopsis] inermis 20-100, Phleum pratense 30 cm onward), NE Conger, Freeborn Co. Minn., June 18, 1991. Adults associated with Poa pratensis, Falcon County Park, Jefferson Co. Colo., June 27, 1992. HOSTPLANTS: Agrostis gigantea, Poa pratensis, and P. agassizensis are all hosts. Adults always occur in moist valley bottoms, so moist-soil grasses such as A. gigantea and P. pratensis are likely to be the major hosts. Adults do not occur on Poa pratensis lawns in Denver, which may mean that they do not prefer this grass or adults may prefer long-grass for oviposition. Larvae eat P. pratensis in the lab; sedges were not tested. Three hosts cited by H. Tietz (Agropyron repens [as "Triticum repens"], Echinochloa crusgalli [as "Panicum crusgalli"], Phleum pratense) are errors, because Tietz' Lepid. of Pennsylvania cites them as hosts yet his references listed do not contain them; the three were cited by Tietz and Scudder's Butterflies of New England as hosts of P. themistocles, based on grasses eaten in the lab by Fletcher's larvae, therefore they are errors based on lab feeding of P. themistocles. Tietz' "Index to Life Histories.." listing of Carex also seems to be an error for mystic; thus only my hosts are proven P. mystic hosts. Half-grown larvae must hibernate. EGG without flange at base, not glued on. Evidently eggs are laid with so little glue that they immediately or very soon fall to the litter. 1ST-STAGE LARVA pale; collar & head blackish. MATURE LARVA brown without markings except for middorsal blackish-brown line T3-A10, a faint supraspiracular slightly-darker brown band, A10 top unmarked brown, underside of A7 and A8 white due to waxy-powder gland; neck cream, prothoracic shield and head black. PUPA black (very dark brown), blackish-brown on abdomen, a lateral blackish band on abdomen, with joints A4-5, 5-6, 6-7 tan, A2-7 spiracles tan, cremaster reddish-brown, proboscis red-brown where it extends beyond wings 5 mm approx. to anal groove, grooves between proboscis-legs-antennae tan, groove at edge of wing tan.

Polites sonora utahensis (Skin.). Adults associated with Poa pratensis and other meadow grasses; Fraser, Grand Co. Colo., July 31, Aug. 1-2, 1990. Many hours searching here produced no eggs or larval nests, evidently because eggs

lack glue and fall to the litter when laid, and larvae probably tunnel into soil (explaining the absence of aerial nests); a female from Fraser Aug. 1 laid ~29 eggs in lab, NONE of which was glued to anything, thus all fell to bottom of container; larvae ate Poa pratensis in lab. Half-grown larvae no doubt hibernate in nature. In lab, oviposition to adults takes 9-11 weeks. EGG not glued on, pale green when laid, developing an orangish flush later. 1ST-2ND-STAGE LARVA yellow-cream, neck light orange-brown; head & collar dark-brown. HALF-GROWN-MATURE LARVA light-reddish-brown on A1-front of A8, tan-gray on T1-3, A9, top of A1, top and rear of A8, and side of A10, heart-line dark brown (strong on abdomen, weak on T3, absent on T1-2), a tan cleavage line on T1-3 of mature larva, A10 top unmarked light brown, legs black; head & collar black. PUPA very similar to P. mystic, black, wings bluish-black, A2-3 spiracles orangish, A4-7 spiracles yellow-tan, intersegmental membranes A4-7 (and to a lesser extent A7-8) yellow-tan, cremaster tip chitin-red-brown, abdomen yellow-tan beneath proboscis on A4-8, proboscis blackish-brown & extending 4-5 mm beyond wings to end of A7 or to end of cremaster (usually to middle of cremaster).

Polites themistocles (Latr.). Adults associated with Poa pratensis, Morse Park, Jefferson Co. Colo., Aug. 12, Aug. 31, 1987. Preoviposition 12:26 near various grasses, preoviposition 11:28 Poa pratensis, preoviposition 11:29 P. pratensis, Guy Hill, Jefferson Co. Colo., June 14, 1988. Oviposition 12:50 (#95) on underside of Astragalus adsurgens var. robustior leaf (Poa pratensis thick 0-1 m, Agropyron [Elymus="Sitanion"] longifolius 5, 15, 60, 60, 60, 80, 90, Stipa comata 20, 30, 30, 40-70 etc. onward, old Bromus (Anisantha) tectorum 50, Bouteloua (Chondrosium) gracilis 25-40); oviposition (#96) 12:54 on underside of Astragalus adsurgens var. robustior leaf (Poa pratensis thick 0-100, Stipa comata 10, 30, 10-1 m etc., Bouteloua gracilis 0-1 m, Agropyron [Elymus="Sitanion"] longifolius 25, 60, 80); preoviposition 13:15 bent abdomen twice on underside of Gnaphalium leaf in Poa pratensis sward (P. pratensis 0-1 m, Stipa comata 10-1 m); preoviposition 13:55 bent abdomen twice on underside of Heterotheca villosa leaves in Poa pratensis sward; preoviposition 12:40 bent abdomen on underside of Astragalus adsurgens var. robustior leaf in Poa pratensis sward; egg (#99) found on Koeleria macrantha (K. macrantha 15-35, 25, 45, 50, 50-80 onward, Stipa comata 15, 15, 20, 20, 25-1 m common, Agropyron [Elymus="Sitanion"] longifolius 20, 35, 35, 90, Poa pratensis 5-1 m); all Guy Hill, Jefferson Co. Colo., June 27, 1988. Female 13:59 hovered over Bromus (Bromopsis) inermis, flew, hovered over it again and bent abdomen to a leaf of it, no egg seen or found; adults common in B. inermis/Poa pratensis meadow Aug. 6-23, 1990, so presumably one of them is probably a host, but considerable time spent watching adults produced no ovipositions, and no eggs were found on these grasses (however females may occasionally let eggs drop from the abdomen? as do Polites sonora and P. mystic often); Wheatridge, Jefferson Co. Colo., Aug. 18, 1990. HOSTPLANTS: Poa pratensis is probably the major host, explaining why P. themistocles is common on Denver P. pratensis lawns; Koeleria macrantha is an occasional host. A. Shapiro (Butterflies of the Delaware Valley) stated (without documentation) that the smaller Panicum species are preferred; Panicum is scarce or absent where themistocles flies in Colo. Most eggs are laid on underside of dicotyledon leaves near host grasses (in comparison, 44% are laid there in P. draco, and this quirk was not noted in other Polites). Larvae must make silk tunnels in litter/soil (in contrast to the aerial nests of Polites origenes), because adults are common on Poa pratensis lawns where no aerial nests occur (and would be chopped off by lawn mowers if they did). Half-grown larvae must hibernate. EARLY STAGES (from egg laid by female from Wheatridge, Jefferson Co. Colo., Sept. 7, 1991, pupated Oct. 28): EGG cream, becoming dirty cream with numerous small red spots (each spot formed of ~50 red microdots) so overall appearance of egg becomes mottled pale-pinkish; hemispherical in dorsal view, lower edge rounded very little, without flange. 1ST-STAGE LARVA tan, collar & head black. YOUNG LARVA yellow-brown (more greenish anteriorly), collar & head black. HALF-GROWN LARVA brown, heart-band dark-brown, A10 top has black mark on top resembling two U's fused together (the open end anterior); head black with brown stripe along coronal sulcus. MATURE LARVA brown (ochre-brown on abdomen, thorax more gray-brown perhaps with a slight greenish tint), heart-band dark brown, A10 top is tan with black markings consisting of black U-shaped rim around top and a blackish subdorsal band and a blackish middorsal band (both bands extending from front of segment to black rim), collar black and edged with whitish anteriorly; head black, a brown stripe along coronal sulcus, adfrontal area brown, a tiny brown spot on lower frontoclypeus (one left, one right), a brown spot medial to eyes and a smaller one near first (solitary) eye. PUPA on 1st & 2nd days head-T2 grass green except wings greenish-tan where they cover abd., heart blackish-green on T2 and brownish on abd. (darkest on A5-8),

abdomen tan with many brown patches, green intersegmental areas A4-8, with many long tan hairs except on wings, proboscis extends 2.5 mm beyond wings, cremaster red-brown; pupa 4th day olive-green, head a bit darker (with brown areas including a brown spot on top near middorsal axis, a smaller brown spot on front, light-brown above labrum, brown ventral to orbit, antenna base brown on each side), proboscis a bit darker, T1 has row of tiny brown dots on front and brown transverse line near rear, T1 spiracle red-brown, distal half of wings greenish-cream, rear of T2 brownish-green, abd. orangish-greenish-tan on A1-4, mottled slightly-greenish cream on A5-9 (due to cream mottled fat body inside), A2-7 spiracles orange-brown, A1-8 has middorsal-dark green (brownier on the brownier segments) band, lenticles present on abdomen (near-middorsal on A2-5, subdorsal on A1-8, about 2-4 on a mound beside proboscis on A4-6), rear part of proboscis and hindlegs orange-brown on A4-5, movable areas of A4-7 smooth, rest of abdomen rough, with tan hairs all over pupa except wings, cremaster red-brown.

Polites origenes rhena (Edw.). Oviposition 10:45 on underside of Andropogon gerardii leaf, Red Rocks, Jefferson Co. Colo., July 11, 1984. 5 eggs (pale green like eggs laid by identified females) found on A. gerardii leaves, Red Rocks, Jefferson Co. Colo., July 12, 1984. Oviposition 8:54 on underside of A. gerardii leaf, Red Rocks, July 4, 1985. Oviposition 9:38 on underside of A. gerardii leaf, Red Rocks, Jefferson Co. Colo., July 4, 1988. 5 larvae 1-1.5 (most 1.5) cm long with blackish-brown heads (4th stage?) found in A. gerardii leaf tube nests, 1 male 3 females reared to adults; Apex Gulch, Jefferson Co. Colo., Aug. 24, 1990. Black-head (resembled origenes, died) larva found in A. gerardii leaf tube nest; Apex Gulch, Jefferson Co. Colo., Aug. 27, 1990. Black-head larva 7 mm long found in A. gerardii leaf tube nest ~20 cm above ground (female reared to adult); Green Mtn., Jefferson Co. Colo., Aug. 28, 1990. Larva (prob. origenes, parasitized) 9 mm long with black head found in A. gerardii leaf tube; Mother Cabrini Shrine, Jefferson Co. Colo., Aug. 30, 1990. 2 larvae 15 & 11 mm long with black heads in rolled-leaf tubes (heads upward) on A. gerardii (2 females reared to adults); Green Mtn., Jefferson Co. Colo., Sept. 1, 1990. Larva 15 mm long found in A. gerardii leaf tube (1 male reared to adult); Van Bibber Creek, Jefferson Co. Colo., Sept. 10, 1990. ~22 half-grown larvae found in A. gerardii leaf nests (nests of ~8-cm-long tubes of 2-3 leaves silked together, the tips eaten off, no stilts, ~10-15 cm above ground) (8 males 6 females reared to adults emgd. Nov. 3-22); 5 half-grown larvae found in leaf nests of several Panicum (now Dichanthelium) oligosanthes var. scribnerianum leaves silked together (~10 cm above ground on 15-20 cm tall plants) (1 parasitized, 2 died as pupae, 2 males reared to adults emgd. Nov. 7-9); Panicum virgatum common but no larvae were found on it so it is definitely rejected by females; Horsetooth Res., Larimer Co. Colo., Sept. 14-15, 1990. 2 larvae 8 mm long with chestnut-brown heads (3rd stage?) found on Bouteloua curtipendula leaf nests (1 male 1 female reared to adults), larvae evidently grew more slowly on this plant because larvae were younger than those found on Andropogon gerardii at this site the next day; Apex Gulch, Jefferson Co. Colo., Aug. 23, 1990. HOSTPLANTS: Obviously A. gerardii is the main hostplant in this area (the A. scoparius host in Scott 1986b was a misidentification of A. gerardii), and B. curtipendula and P. oligosanthes are occasional hosts; all are wide-leaved comparatively short grasses growing on open S-, E-, or W-facing slopes. P. origenes is evidently the only Polites that makes aerial nests, and its hostplants (mostly Andropogon gerardii) have wider leaves than hosts of other Polites; it is convergent to Hesperia ottoe in all these traits. Half-grown larvae must hibernate. EGG greenish-cream. ~3RD-STAGE LARVA ochre-tan, insides mostly green on T2-A5 and A6-7, heart very-slightly darker, neck brown behind head but white in front of collar, collar black; head chestnut-brown with a dark-brown vertical stripe near coronal sulcus. ~4TH-STAGE LARVA same as mature larva, but medium- or somewhat dark-brown, some larvae with a slight pinkish tinge on sides and rear and on T1. MATURE LARVAE brown (microscopically dotted with brown patches), but many larvae of both sexes pinkish-reddish brown (most mature larvae are at least slightly reddish, but some of both sexes are brownier), several larvae definitely brown-pink in color, A10 top blacker brown (no black bands or rim), heart-band dark brown, neck brown just behind head but cream in front of the black collar; head black. PUPA head & thorax brown or blackish-brown (sometimes light brown, sometimes slightly-olive brown), top of abdomen light brown to brown or (when larva was reddish) reddish-brown, with middorsal darker-brown patches (occasionally a long brown heart-band), underside of abdomen paler (tan-brown or tan), rear 40% of A4-6 tan (sometimes slightly-greenish tan on first day), wings tan (slightly- or definitely-greenish tan on first day), male wings have 2 brown stigma patches, top half of abdomen has several transverse rows of small blackish dashes & dots, below abdomen spiracle

are several tiny dots in front of a larger dot, sometimes there are 2 small brown supraventral dots and a 3rd dot near midventral plane, a supraventral hairy hill with ~7 oval lenticles on A4,5,6, T1 spiracle & cremaster orange-brown, appendages tan or light brown (sometimes brown), proboscis base usually brown, proboscis tip orange-brown where it extends 6-7 mm beyond wings (usually to cremaster base, sometimes to rear of A8 or to middle of cremaster). Pupa lasts ~18 days in lab (mean 18.0 males 17.5 females, s.d. 1.5 males 1.7 females, range 16-21 males 14-20 females, N=10 males 8 females).

Atrytone aroqos (Bdv. & LeC.). Oviposition 11:10 on underside of leaf of Andropogon gerardii, Red Rocks, Jefferson Co. Colo., July 15, 1984; adults associated with A. gerardii at Red Rocks, 1973-1988. Two eggs found with a wide lower red ring and a narrow upper red ring, one egg found with only one wide red ring, hatched into cream larvae with orangish heads (NOTE: this record I formerly misidentified as Anatrytone logan; they are obviously aroqos because the resulting 1st-stage larvae have orangish heads [logan has black heads]) found on leaves of A. gerardii, Red Rocks, Jefferson Co. Colo., July 12, 1984. Adults associated with A. gerardii, Chimney Gulch, Jefferson Co. Colo., July 2, 1985, July 1, 1986. Adults associated with A. gerardii, Mt. Zion, Jefferson Co. Colo., July 1, 1986. 3 larvae 20, 25, 30 mm long in rolled-leaf nests of 2-3 leaves in center of big A. gerardii clumps, they eat leaf tips and chew notches out of leaves just above and below the nest; Apex Gulch, Jefferson Co. Colo., June 4, 1990. 3 large larvae found in rolled leaf nests on A. gerardii; Apex Gulch, Jefferson Co. Colo., June 5, 1990. Larva 12 mm long (parasitized) and 8 pupae (1 hatched shell, 2 about to emerge but dead, 3 dead, 2 yellow due to parasitoids), all on A. gerardii; Red Rocks, Jefferson Co. Colo., June 30, 1990. 1 head capsule in one nest & live pupa (female emerged July 21) found in other nest, both in A. gerardii leaf-tube nests; ridgetop, Green Mtn., Jefferson Co. Colo., July 12, 1990. Empty pupal shell and head capsule found in leaf nest of ~3 leaves of A. gerardii; Falcon County Park, Jefferson Co. Colo., July 18, 1990. No silk girdle, and cremaster not attached. Larva 1.5 cm long, 3 larvae 1 cm long, & 2 pupal shells with head capsules, all found in A. gerardii leaf tubes; Apex Gulch, Jefferson Co. Colo., Aug. 24, 1990. 2 larvae (6 & 7 mm long), and 4 pupal shells with cast head capsules, all found in A. gerardii leaf tube nests; Green Mtn., Jefferson Co. Colo., Aug. 28, 1990. Larva 10 mm long and 3 pupal shells found in A. gerardii leaf tubes; Mother Cabrini Shrine, Jefferson Co. Colo., Aug. 30, 1990. 4 pupae, 1 pupal nest with head capsule and pupal shell blown away, 5 larvae (10, 12, 13, 15, 20 mm long), all found in rolled-leaf A. gerardii nests; Green Mtn., Jefferson Co. Colo., Sept. 1, 1990. 1 larva 7.5 mm long, 1 dead putrifying larva 17 mm long, 1 pupal shell, all found in A. gerardii leaf nests; Mt. Vernon Historic Site, Jefferson Co. Colo., Sept. 3, 1990. 5 larvae 11-15 mm long found in A. gerardii rolled-leaf nests (some of 2 leaves); Van Bibber Creek, Jefferson Co. Colo., Sept. 10, 1990. ~50 larvae (incredibly abundant, only 1-2 min. were needed to find each larva) 13-17 mm long, and 2 live pupae (2 females emerged Sept. 25, 27), found in leaf nests on A. gerardii, usually ~10-20 cm above ground, the typical larval nest rests on two "stilts", and consists of two vertical leaf bases, then a 2-3 cm area where both leaves are chewed almost down to the midrib (the stilts), then a rolled leaf tube 2-3 cm long, the upper distal end closed by a silk screen, this may be a hibernation nest because it was not noted previously earlier in the summer; Panicum virgatum was common and Panicum (now Dichanthelium) oligosanthes var. scribnerianum was fairly common, but no larvae were found on them so they are definitely rejected by females; Horsetooth Res., Larimer Co. Colo., Sept. 14-15, 1990. Larva 19 mm long found A. gerardii leaf nest between stem and leaf; Apex Gulch, Jefferson Co. Colo., Sept. 19, 1990. Pupal shell in A. gerardii leaf tube (leaves eaten beside it so it was larval nest also), Apex Gulch, Jefferson Co. Colo., Sept. 5, 1991. Pupa & head capsule found in leaf tube, leaf tube found with only mature larval head capsule, both on A. gerardii; larva 10 mm long found in Bouteloua curtipendula leaf tube nest; Apex Gulch, Jefferson Co. Colo., Aug. 27, 1990. 1 pupal shell with cast head found on B. curtipendula leaf nest 3 cm long; Apex Gulch, Jefferson Co. Colo., Aug. 23, 1990. Adults associated with A. gerardii, 3.5 mi. S Yankton, Cedar Co. Neb., July 10, 1986. Adults associated with A. gerardii, 3 mi. NE Holland, Pipestone Co., Minn., July 11, 1986. Adults associated with A. gerardii, 2 mi. E. Renville County Park, Renville Co., Minn., July 12, 1986. Adults associated with A. gerardii, 4 mi. S. Hopeton, Woods Co., Okla., Sept. 3, 1986. Adults associated with Andropogon (Schizachyrium) scoparius, 5-10 mi W Medicine Lodge, Barber Co. Kan., Sept. 2, 1986. HOSTPLANTS: Obviously Andropogon gerardii is by far the favorite host, Bouteloua curtipendula is a rare host; Andropogon scoparius may be a popular host in E U.S. and S Kansas, but it is shunned in Colo. There is only one generation in Colo. (mostly July), but a rare partial 2nd generation was proven

by finding 2 pupae in nature in Sept. 14-15 that emerged Sept. 25-27. Half-grown larvae hibernate. EGG slightly-yellowish-cream, after a few days developing a diffuse pinkish-red ring around egg and another small pinkish-red ring around top (this ring sometimes absent or forming a spot), the two rings sometimes coalescing into a rosy flush on one side of egg and one egg mostly red-pink; the reddish rings disappear 2 days before hatching; A. aroqos eggs are much less yellow than Anatrytone logan and the red rings are much broader and much more diffuse-margined; shape nearly round in dorsal view, bottom edge is more angled than A. logan with a distinct flare outward at the bottom edge. FIRST-STAGE LARVA cream-yellow-tan, collar blackish-brown; head brownish-orange with a tan stripe just lateral to inverted Y-shaped sulcus. OLDER LARVAE green-cream or creamy-green, paler yellowish-green between segments, dark-gray-green heart-band, collar light-green with just a very narrow tan transverse line running down its middle; head pale-tan with orange-brown (orangish-black on front of head of some larvae) marks (a vertical spike up center of frontoclypeus almost to its top, a wishbone-shaped mark on frontoclypeal sulci, a narrow or fairly wide band runs from near top of head down near coronal sulcus [coronal band is pale-tan] to adfrontal cleavage line and runs along it to bottom of head, a wide band starts just above and in front of eye #6 and runs upward and narrows and stops near top of head [this band may have tan dots in it laterally], a fairly wide band on posterior rim of head runs from level of eye #5 almost to coronal sulcus; none of these stripes are connected on top of head), labrum light brown, brown beside labrum. PUPA (palest individual, female) yellow-cream, edges of orbit grayish, T1 spiracle an orangish or red-brown tall hill, proboscis tan where it extends past wings to rear of A4 or A5 (rarely A6), no silk girdle, cremaster wide, short (0.5 mm long), with no setae or crochets and not attached, just before emergence eye turns red, then thorax turns brown, wings orange-brown, abdomen orangish-yellow. Some pupae have head smoky-gray and sometimes have black on rear rim of T2 & T3, others have front of head and front of T1 blackish-brown, and a few have light-gray wings. The darkest pupae (mostly males) greenish-cream, turning cream in a day or two, head & thorax blackish-gray, T3, wings, & appendages dark-gray, wing veins slightly-paler gray, dorsal 40% of A1-8 (except intersegmental areas) medium gray. Pupae are very variable, from almost-completely yellow-cream to half smoky-black, and the sexes differ: females vary from very pale to usually rather pale to sometimes nearly as smoky as males; males are usually smoky, sometimes rather pale. This is the only butterfly I know of with such great color differences between the sexes of immatures.

Anatrytone logan logan (Edw.). Nearly-mature larva (reared to adult) found in rolled-leaf nest of 4 leaves of Bromus (Bromopsis) inermis 35-cm-tall plant in roadside ditch (B. inermis 0-100 common, Phleum pratense 15, 20, 40, 50, 90 etc., Phalaris arundinacea 35, 35, 35, 90, Poa pratensis 20, 20, 35, 70 etc.); NE Conger, Freeborn Co. Minn., June 12, 1990. Careful study of larvae, pupae, adults, hosts, and behavior clearly prove that logan does not belong in the same genus with Atrytone aroqos (Table 8); so I place it in its own genus Anatrytone until a better place can be found. (In contrast, Hesperia and Polites are identical in nearly every respect, Stinga resembles Ochlodes, etc., so some of these genera may have to be lumped.) Half-grown larvae must hibernate. MATURE LARVA light-bluish-green, heart darker-blue-green, collar black (wide esp. laterally), suranal plate has 2 anterior transverse black streaks that resemble eyebrows, T1 spiracle black, A8 spiracle almost as large but brown; head black with 3 cream vertical stripes (a medial stripe running parallel to coronal sulcus from top of head almost to adfrontal sulcus, then continuing straight down through lateral 2/3 of adfrontal area, a cream stripe starting from in front of [and touching] eyes #3-5 and extending vertically to near top of head, a short cream lateral dash encloses eye #1 and tapers upward to a point just below level of top of frontoclypeus), labrum cream. The pattern on head (vertical stripes not paralleling sulci) and suranal plate are unique. PUPA black, with a narrow greenish-cream streak running above last half of forewing, which very narrowly extends along wing to greenish-cream ventral 40% of A4, the posterior 40% of A4, A5, and A6 have a greenish-cream margin (dorsally narrowed because margin is anteriorly gray), a small greenish-cream spot around spiracles on A4-7, a black supra-ventral dot is on A4 lateral to proboscis (the same dots on A5 & 6 are hills lost in edge of anterior black area, all 3 dots have hair and lenticles), proboscis extends 7 mm beyond wings to base of cremaster, cremaster narrow, 1 mm long, with many long unhooked setae (unhooked crochets), but one anteriorly-directed black spine extends from cremaster tip that hooks into nest wall; no silk girdle; duration 12-13 days in lab.

Anatrytone logan laqus (Edw.). (Note: a former record on Andropogon gerardii from Red Rocks, Jefferson Co. Colo., July 12, 1984, represents Atrytone aroqos

based on the first-stage larva.) No larvae found on *Sorghastrum nutans*, *Panicum virgatum*, *Panicum (Dichanthelium) oligosanthos* var. *scribneriana*, *Agropyron*, and a few *Dactylis glomerata* under bushes, *Agrostis gigantea*, *Bromus [Bromopsis] inermis*, *Agropyron elongatum*, Marshall, Boulder Co. Colo., Aug. 29, 1991 (adults occur here every year). Egg yellowish-cream when laid, becoming pale-yellow and developing a red lower ring around egg and a small red ring on top (rings lost just before hatching); shape slightly oval in dorsal view, lower edge slightly rounded (not sharp as in *A. aroqos*). 1ST-STAGE LARVA yellow-cream (after feeding has greenish innards), heart-line weakly blue-green, narrow black collar (collar a bit longer than that of *A. aroqos*; head black. 2RD-STAGE LARVA cream-tan, A10 top (suranal plate) tan with a black crescent-shaped posterior rim and a black crescent across top of A10, collar black; head ochre (possibly cream when live) with dark-red-brown pattern (a wide band along coronal sulcus, a narrow vertical streak down middle of frontoclypeus, a narrow streak down side of frontoclypeus, a dark-red-brown line along adfrontal sulcus [these 3 all join coronal band], a wide vertical band lateral to adfrontal sulcus extending to top of head and joining next band, a wide band extending from anterior eyes 3-6 dorsally then curving medially to coronal sulcus on top of head, rear rim of head brown [this brown rim very narrow dorsally]), labrum pale, brown beside labrum.

Table 8. Differences between *Atrytone* and *Anatrytone*.

Trait	<i>Atrytone aroqos</i>	<i>Anatrytone logan</i>
tibia of adult middle leg	smooth	some short spines
male genitalia	aedeagus broader, uncus narrower	saccus longer, valva with terminal flap
mating time	late afternoon (13:20-17:45) under clouds	all day in sun
mating location	males perch near host on hillsides	males perch in gulch bottoms
larval hosts	wide-leaf bunch-grass (<i>Andropogon gerardii</i>)	hay-grass (<i>Bromus inermis</i> etc.)
egg	pinkish-red rings much broader & more diffuse, egg more cream; nearly round in dorsal view, lower edge angled outward	red rings narrow & sharp, egg much yellower; sl. oval in dorsal view, lower edge sl. rounded
1st-stage larva head	brownish-orange	black
older larva head	mostly tan with red-brown bands, the median bands are narrow and parallel sulci	black with 3 vertical white stripes that do not parallel sulci
older larva collar	light green	black
older larva body color	greenish-cream	light-bluish-green
older larva suranal plate	no dark marks	2 transverse "eyebrow"-shaped marks
pupa	yellow-cream; on males and some females blackish-gray on head, thorax, & front of abd.segments (abdomen has black only dorsally)	black, with greenish-cream above last half of wing and on movable interseg. areas of A4-7 (abdomen has black rings all around segments A4-7)
pupal hair	small hairs	very hairy

pupal	extends 1-2.5 mm	extends 7 mm beyond
proboscis	beyond wings	wings to cremaster
pupal	0.5 mm, no setae &	1 mm, many unhooked
cremaster	no crochets,	setae,
	no recurved spine	1 recurved spine
pupal T1 spiracle plateau	small	twice as large

Note: While on the subject of generic limits of *Atrytone*, it should be noted that based on adult morphology "*Atrytone*" *potosiensis* Freem. obviously belongs to genus *Mellana potosiensis* new combination.

Ochlodes yuma yuma (Edw.). Oviposition on *Phragmites australis* basal leaf, NE jct. Hwy. 160 and Hatch Wash, San Juan Co. Utah, Aug. 23, 1974. Adults are associated with this plant at all sites throughout its range, apparently one of very few Hesperiniinae skippers that are restricted to one hostplant species (Scott et al. 1977).

Ochlodes yuma unnamed ssp. Adults associated with *Phragmites australis*, Rio Grande Recreation Area, Taos Co., New Mex., Aug. 1987.

Ochlodes sylvanoides sylvanoides (Bdv.) (= *napa* [Edw.]). 1 pupal shell & shed larval skin (head ~2.9 mm wide, with typical *O. sylvanoides* bicolored color pattern) found in silk nest (the leaf top was silked over an area 37 x 10 mm on which the pupa reposed, the leaf folded upward into a U-shape) on *Agropyron* (*Elyttrigia*) *repens*, Wheatridge, Jefferson Co. Colo., Aug. 22, 1988. Preoviposition 10:50 bent abdomen on underside of dead dried *Dactylis glomerata* leaf 2/3 m above ground, Chimney Gulch, Jefferson Co. Colo., Aug. 30, 1988. A 1.5-mm-wide head capsule found in 7-cm-long leaf nest on *Leucopoa kingii*, a parasitized larva including head (body filled with 7-mm-long elliptical fly? pupa) found in 6-cm-long leaf nest on *L. kingii*, a dead pupa and cast larval skin & head capsule found in 5-cm-long leaf nest on *L. kingii*, 1 dead pupa (hole in head as if parasites emerged or ?ants attacked) with cast larval skin & head found in 5-cm-long leaf nest on *L. kingii*, a molted larval skin (no head) found in 4-cm-long leaf nest on *L. kingii*, 4 empty leaf nests 7, 7, 8, 8 cm long found on *L. kingii*, 1 dead larva & head with empty parasitoid fly pupa inside found in leaf nest on *Agropyron* (*Leymus*) *ambiguus*, 1 empty 7-cm-long leaf nest found on *A. (L.) ambiguus*, 1 empty larval nest (probably of *O. sylvanoides* because *sylvanoides* is common here and site is far from the gulch/creek habitat of *Poaes zabulon taxiles*) found on *Bromus* (*Bromopsis*) *pumpellianus*, Ralston Butte, Jefferson Co. Colo., Aug. 14, 1989. 4 nests with larval remains found (6-cm-long nest of 3 leaves with a half-grown head capsule, 6 cm nest of 2 leaves and a half-grown dead parasitized larva, 4 cm nest of 3 leaves & head capsule, 6 cm nest of 3 leaves and a half-grown head capsule), 9 empty larval nests found (7-cm-long nest of 4 leaves, 7 cm of 2 leaves, 6 of 2, 6 of 4, 6 of 7, 7 of 4, 8 of 2, 4 of 2, a 3 cm nest of leaf tip bent into litter of clump base), 6 pupal nests found (7 cm-long nest of 3 leaves and cast head & skin of larva & part of pupal shell, 6 cm nest of 4 leaves and 3 fly pupal shells, 5 cm nest of several leaves with pupal shell, 7 cm nest of 4 leaves & pupal shell, 5 cm nest of 3 leaves with a long fly pupa, 6 cm nest of 4 leaves with dead pupa and on same plant a 6 cm nest of 4 leaves & half-grown head capsule), all on *Leucopoa kingii*; 2 empty larval nests found on *Bromus* (*Bromopsis*) *inermis* (6-cm-long nest of 3 leaves, 4 cm nest of 2 leaves); an empty 6-cm-long nest of 3 leaves found on *Agropyron* (*Leymus*) *ambiguus*; pupal nests generally show no nearby feeding damage, which proves that larvae usually or often make a new leaf nest before pupating; all Ralston Butte, Jefferson Co. Colo., Aug. 16, 1989. Mature larva found in nest of 2 *Phleum pratense* leaves silked together (larva eats leaf distal to nest); a nest of 2 *Phleum pratense* leaves contained a shriveled 1-cm-long larva (identified by head color pattern) and a parasitoid cocoon and pupa; 2 empty nests of 2 & 3 leaves found on *P. pratense* and 1 empty nest of 3 leaves found on *Agrostis gigantea* are probably *O. sylvanoides*, but could be *Poaes zabulon taxiles*; Tucker Gulch, Jefferson Co. Colo., July 13, 1989. 4-cm-long silked-leaf nest of 3 leaves with a 1.5-mm-wide head capsule inside, found on *Agropyron* (*Elyttrigia*) *repens*, 2 other empty nests of 3 leaves found on *A. repens*, Tucker Gulch, Jefferson Co. Colo., July 27, 1989. Preoviposition 11:40 she bent abdomen under dead *Bromus* (*Bromopsis*) *pumpellianus* leaf (4 mm wide) 15 cm up on 50 cm tall plant and bent abdomen under a nearby more vertical dead leaf of *B. pumpellianus*; 2 empty larval nests (probably *sylvanoides*, perhaps *Poaes zabulon taxiles*) of 3 and 4 leaves on *Calamagrostis purpurascens*; N

Genesee Mtn., Jefferson Co. Colo., Aug. 29, 1989. Cast larval skin found in 4-cm-long silked-leaf tube of 3 leaves of Calamagrostis purpurascens, Chief Hosa Lodge, Jefferson Co. Colo., Aug. 16, 1989. 1 empty silked-leaf nest of 5 leaves (probably O. sylvanoides) found on Calamagrostis purpurascens, Tinytown, Jefferson Co. Colo., Aug. 21, 1989. Preoviposition 9:30 on dead lower leaves of Phalaris (Phalaroides) arundinacea; preoviposition 12:32 on Bromus (Bromopsis) inermis dead leaf ~40 cm above ground; oviposition 13:32, she landed on a green Bromus (Bromopsis) inermis leaf then on a nearby 40%-dead Atriplex patula leaf (40 cm above ground) and bent abdomen under it, then landed on a Bromus (Bromopsis) inermis leaf and bent abdomen under it, then flew to same A. patula leaf and laid egg under green part of leaf next to dead part, this was in a Bromus (Bromopsis) inermis patch; 6 eggs found on dead Bromus (Bromopsis) inermis leaf undersides ~40 cm above ground on ~90-100-cm-tall plants, the leaves 3-7 mm wide; 4 eggs found on dead Agropyron (Elytrigia) repens leaf undersides ~35-40 cm above ground on ~80 cm tall plants, the leaves 4-8 mm wide; 4 eggs found on dead (one green) Dactylis glomerata leaf undersides ~10, 20, 45, 45 cm above ground, the leaves 4-6 mm wide; all these eggs were in areas shaded most of the day; the oviposition and all eggs were found near Arctium minus flowers that many adults fed on, so the flowers evidently attracted the females who then oviposited nearby; Wheatridge, Jefferson Co. Colo., Aug. 22, 1989. A 2-cm-long leaf nest found on Agropyron (Leymus) ambiguus had an empty wasp pupa and an A10 segment of cast larval skin showing the dorsal lenticle of O. sylvanoides, a 2.5-cm-long empty silk nest (probably O. sylvanoides) found in A. (L.) ambiguus, Lookout Mtn., Jefferson Co. Colo., Sept. 2, 1989. 1 dead half-grown larva with 6-mm-long fly pupa inside found on Agropyron (Leymus) ambiguus leaf nest, 1 empty 6-cm-long silked-leaf nest found on A. (L.) ambiguus, 1 egg found on underside of dead 6-mm-wide leaf 45 cm above ground on ~70-cm-tall Agropyron (Elymus) canadensis plant, 1 egg found on Muhlenbergia racemosa under green leaf 60 cm up on 80 cm plant, 1 hatched egg (probably O. sylvanoides) found on Agropyron (Elymus) trachycaulum on 5-mm-wide dead leaf underside, 1 empty larval nest (probably O. sylvanoides) found on Bromus (Bromopsis) lanatipes, Apex Gulch, Jefferson Co. Colo., Aug. 24, 1989. 1 egg found on Agrostis gigantea on underside of dead part of leaf (basal 7 cm of the 19-cm-long leaf was green) 27 cm up on 60 cm plant, 3 eggs found on Bromus (Bromopsis) inermis leaf undersides (one leaf dead, one mostly dead, one green) ~30 cm up on ~50 cm plants, Van Bibber Creek, Jefferson Co. Colo., Aug. 28, 1989. 4 eggs found on Phalaris (Phalaroides) arundinacea (1 hatched egg under 8-mm-wide dead leaf, 2 cream eggs under 8-mm-wide dead leaves, 1 cream egg under 8-mm-wide leaf that was mostly-green with 1.5-mm-wide dead brown edge), the eggs 40, 50, 50, 70 cm above ground on the N edge of a patch of ~120 cm tall plants, Wheatridge, Jefferson Co. Colo., Aug. 30, 1989. 3 eggs found on underside of dead lower leaves of Bromus (Bromopsis) lanatipes (one egg had a Trichogrammatidae wasp crawling on it), an empty 3-cm-long silked-tube-nest (probably O. sylvanoides) found on Agropyron (Leymus) ambiguus, an empty 6-cm-long silk-leaf-nest (leaves chewed off distally) (probably O. sylvanoides) found on Calamagrostis purpurascens, Indian Peak, Jefferson Co. Colo., Sept. 2, 1989. Preoviposition 11:05 she bent abdomen 4X on underside of Agropyron (Leymus) ambiguus lower leaves; 2 eggs found on underside of dead 5-mm-wide lower leaf of A. (L.) ambiguus; egg found on underside of 6-mm-wide dead lower leaf of Agropyron (Elytrigia) repens; 6 eggs found on underside of dead lower leaves (leaves 3, 4, 4, 4, 4, 4.5 mm wide) of Agropyron (Elymus) trachycaulum; 1 egg with Trichogrammatid exit hole found on underside of Bromus (Bromopsis) lanatipes lower leaf; Red Rocks, Jefferson Co. Colo., Sept. 4, 1989. 1 silked-leaf nest of ~4 leaves found on Agropyron (Leymus) ambiguus contained a 3 X 3 mm piece of O. sylvanoides pupal shell, a 3 X 1.5 mm piece of O. sylvanoides wing (with orange, dark-brown, and fringe scales present), and a ladybird beetle ~6 mm long, evidently the beetle entered the nest and ate part of the pupa; 2 eggs found on underside of dead 5-mm-wide Dactylis glomerata lower leaves ~10-20 cm above ground (D. glomerata has only sprawling basal leaves); 8 eggs found on underside of dead lower leaves (leaves 4, 4, 4, 4.5, 5.5, 5.5, 5.5, 7 mm wide) of Agropyron (Elymus) trachycaulum; 9 Calamagrostis purpurascens plants had empty silked-leaf nests (probably O. sylvanoides) of 3, 3, 3, 3, 4, 5, 5, 6, 7, 7, and 8 leaves; Lookout Mtn., Jefferson Co. Colo., Sept. 4, 1989. 3 eggs found on underside of dead leaves (6, 7, 9 mm wide) 1/3 way up from base of Bromus (Bromopsis) inermis plants, Lookout Mtn., Jefferson Co. Colo., Sept. 6, 1989. 2 eggs found on underside of dead lower leaves (one 5 mm wide) of Agropyron (Elymus) trachycaulum, 1 egg found on underside of dead 5-mm-wide lower leaf of Agropyron (Leymus) ambiguus, Indian Peak, Jefferson Co. Colo., Sept. 14, 1989. Egg found on underside of 5-mm-wide dead lower leaf of Agropyron (Elymus) canadensis, eggshell base found on underside of 4.5-mm-wide dead lower leaf of

A. (E.) canadensis, Falcon County Park, Jefferson Co. Colo., Sept. 20, 1989. Adults associated with Poa pratensis (the only grass in lawn), but adults probably flew in from surrounding areas, Morse Park, Lakewood, Jefferson Co. Colo., Aug. 12, 1987. Larva ~10 mm long found in Agropyron (Elymus) trachycaulum rolled leaf; Mt. Lindo, Jefferson Co. Colo., May 30, 1990. Larva 18-mm-long found in rolled-leaf nest on Agropyron (Leymus) ambiguus; W-facing slope, NE Crawford Gulch, Jefferson Co. Colo., June 20, 1990. 1 larva in rolled-leaf nest on Bromus (Bromopsis) inermis; 5 larvae in rolled-leaf nests, 1 shriveled larva 1.2 cm long, and 1 dead larva 1 cm long, all on Agropyron (Elymus) trachycaulum; all live larvae 1.5-2 cm long; N-facing slope, Tinytown, Jefferson Co. Colo., June 21, 1990. Larva 17 mm long found in Bromus (Bromopsis) lanatipes leaf tube, W-facing part-shaded slope; Tinytown, Jefferson Co. Colo., June 24, 1990. 15-mm-long larva found in Bromus (Bromopsis) inermis leaf tube nest, W-facing slope near gulch; Tinytown, Jefferson Co. Colo., June 25, 1990. 20-mm-long larva found on Agropyron (Elytrigia) repens silked-leaf tube; larva 18 mm long found on Dactylis glomerata leaf tube nest; gulch bottom, Tinytown, Jefferson Co. Colo., June 26, 1990. Dead larva 15 mm long found Agropyron (Elymus) trachycaulum leaf nest on W-facing gulch bank; larva 18 mm long found Agropyron (Elymus) canadensis leaf tube on S-facing sunny road bank; Tinytown, Jefferson Co. Colo., June 28, 1990. 3 larvae ~15 mm long found on Agropyron (Leymus) ambiguus (50 cm above ground in nest of 3 leaves, 25 in 4, 30 in several) (2 on N-facing slope, 1 under NE side of tree in roadside ditch on SE-facing slope); Red Rocks, Jefferson Co. Colo., June 30, 1990. Larva 26 mm long found in Bromus (Bromopsis) inermis leaf tube; dead half-grown larva with 2 fly pupae found in Agropyron (Elymus) trachycaulum rolled-leaf nest; W-facing bank, Tinytown, Jefferson Co. Colo., July 2, 1990. 3 pupae found in Agropyron (Leymus) ambiguus silk nests; N-facing slope of hilltop, Mt. Zion, Jefferson Co. Colo., Aug. 14, 1990. Oviposition 11:30 Agropyron (Elymus) trachycaulum, she hovered near Festuca arundinacea and bent abdomen under Monarda leaves 2X, bent abdomen under 4 dead A. (E.) trachycaulum leaves, laid egg on horizontal green 2-mm-wide A. (E.) trachycaulum leaf underside ~4 cm above ground; N-facing slope 5 m from gulch bottom in full sun; Red Rocks, Jefferson Co. Colo., Sept. 4, 1990. Pupal shell & head capsule found in silked-leaf Agropyron (Leymus) ambiguus tube; N-facing slope just N high ridge, Mt. Lindo, Jefferson Co. Colo., Sept. 6, 1990. Pupa found in nest of 9 leaves (second empty larval nest of 3 leaves nearby) of Agropyron (Leymus) ambiguus, N fork Clear Creek, Gilpin Co. Colo., July 18, 1991. Oviposition 11:02 she hovered then landed on green leaf 4 mm wide 13 cm from leaf tip 15 cm above ground of young Agropyron (Elymus) canadensis (A. canadensis 0-100, Bromus [Bromopsis] lanatipes 40, 50, 50, 100, Carex sp. 10-100, Dactylis glomerata 50), partially shaded gulch Tinytown, Jefferson Co. Colo., Sept. 4, 1991. HOSTPLANTS. All 14 grasses are hostplants (except perhaps Calamagrostis): Leucopoa kinqii (28 records), Agropyron (Elymus) trachycaulum (28), Agropyron (Elymus) ambiguus (21), Bromus (Bromopsis) inermis (19), Calamagrostis purpurascens (14 records, none have definite proof but the large size of some larval nests indicate O. sylvanoides), Agropyron (Elytrigia) repens (10), Dactylis glomerata (8), Bromus (Bromopsis) lanatipes (6), Phalaris arundinacea (5), Phleum pratense (4), Agropyron (Elymus) canadensis (4), Agrostis gigantea (2), Bromus (Bromopsis) pumellianus (2 records, the most poorly-documented host because based only on 1 nest & 1 preoviposition), Muhlenbergia racemosa (1). All are "hay" grasses (wide-leaf tall grasses), the largest being P. arundinacea which is 1.5-2 m tall, the smallest A. gigantea and M. racemosa which are only ~30-60 cm tall; the hostplants are nearly identical to those eaten by the other hay-feeding skippers Piruna pirus, Poanes zabulon taxiles, and Amblyscirtes vialis. L. kinqii is obviously a favorite host, but it is very localized perhaps because it is dioecious; I have seen it only at two localities (only common at one), though it ranges to Calif. OVIPOSITION. Eggs are laid preferably in partial shade (on N-facing nearly-always-wooded slopes or in shady areas near creeks) on the underside of dead leaves ~20-40 cm above ground on wide-leafed usually-tall "hay"-grasses ~20-40 cm above ground, in patches of the host grasses (not on a single isolated small clump). Eggs are laid within patches of green grass, but are placed on dead leaves evidently because first-stage unfed larvae hibernate (therefore do not feed until spring) so there is no necessity to lay on green leaves, and perhaps the egg is safer on a dead leaf from being eaten by a herbivore or predator, and safer from mechanical distortion caused by the shrinkage of a senescing leaf. By laying on a dead leaf, the female may be more certain that the plant grows in a suitable site that will have enough time to sprout, grow leaves, and have them senesce, and that therefore will have enough time to mature the larvae. One of three ovipositions was seen was on a dicotyledon, but oviposition on dicotyledons is probably infrequent because no preoviposition was on them. Adults are usually

found near flowers, and it seemed that immatures and nests were more common near flowers too, evidently because females are drawn there. NEST. Young larvae make a silked-leaf nest by curving the leaf up around them, while older larvae make a nest by silking several leaves together; the nests are the same as those of Poanes. Silked-leaf skipper nests incorporating more than 1 grass leaf take a characteristic form due to the growth of the leaves: the larva starts the nest by silking together leaves that angle upward near the stem, but the upper leaves, being smaller, grow more than the lower leaves, and the stem lengthens, so gradually the nest is aimed downward a little more and the leaf bases (basal to the nest) of the upper leaves curve upward from the stem then downward to the nest. Larvae evidently usually or often make a new leaf nest before pupating, the proof being the lack of feeding damage on leaves near pupal nests. Unfed first-stage larvae hibernate. EARLY STAGES from Jefferson Co.: EGG cream, roughly hemispherical without ribs, the top with a slight indentation $\sim 1/10$ th the egg diameter, with a slight hill in middle of indentation that appears to move (an optical illusion) as the egg is tilted from side to side, duration 12 days. FIRST-STAGE LARVA cream, becoming tan-cream, a long black or dark-brown collar; head black or dark-brown. Unfed first-stage larva hibernates in a silked-leaf nest, the leaf edges tied together by ~ 7 multistrand cords, but in the lab most larvae eventually start to feed, and a larva grew to mature size in 8 weeks eating Poa pratensis. 3RD-STAGE LARVA green, heart-line dark-green, 2 darker green subdorsal bands, a paler green lateral line, collar narrow, black; head black. 4TH-STAGE LARVA dull grayish-cream, heart-band dark-gray, a narrower above a wider gray subdorsal band, body slightly grayer in a wide band above creamy-gray lateral ridge, collar black; head tan, with rear of head black, and a black "kachina doll" on front (complete with feet, pantaloons, hands, tall shoulder pads, the head formed of a black band over coronal sulcus). MATURE LARVA dull yellow-tan, greenish-yellow-tan in middle half or front $2/3$ of body due to food, with numerous tiny dark-green dots all over, with intersegmental interrupted tan rings around body, a sharply-edged middorsal dark green heart-line, two dorsolateral dark bands (due to coalescence of many of the dark-green dots, the lower band darker) (the upper band covers an internal pulsating yellow line) edge a creamy-tan dorsolateral band, a lateral cream band is edged above by a pale gray-tan band, below the lateral cream band the body is green-tan (little darker than ground color), collar black on rear edge and on lateral edge, front of collar white, collar gray between the white front and black rear; head dark red-brown or nearly black on side and rear and top and on a broad band along coronal sulcus, gena and vertex and frontoclypeus-ecdysial area red-brown or tan-brown, vertex and gena to level of top of eyes covered with pits and looks pale red-brown (fewer pits next to coronal dark band producing a slightly paler vertical stripe edging dark coronal band), a broad vertical dash in upper part of frontoclypeus, lower corners of frontoclypeus red-brown, a red-brown line along adfrontal sulcus and lower part of coronal sulcus, a dark red-brown band along adfrontal cleavage line. PUPA pale yellow-tan with a slight grayish bloom (a few pupae have a slight pinkish tinge), wings & head usually darker (light brown) than abdomen, T1-2 spiracle red-brown, rear of T2 blackish-brown, with many tiny blackish-brown dots on abdomen & top of thorax, proboscis light orangish-brown where it extends $\sim 4-5$ mm beyond wings to between base of A8 or base of cremaster, a black dorsal edge to front of A9 and front of A10 and ventral front of A9, A4-6 have a subventral cluster of hairs, eye dark-brown, orbit light-brown and hairless, head has dark-brown internal markings, long hairs over most of body except wings legs proboscis antenna; pupates in a silked-leaf nest of silk-mesh like a screen, the ventral side of pupa upward, hanging attached to top of nest by a silk girdle around body just behind T2 and by cremaster attached to mesh.

Ochlodes snowi (Edw.). Ovipositions 10:25 and 10:35 on underside of leaves of edge of Blepharoneuron tricholepis (B. Scott) clumps (Muhlenbergia montana was within a few cm also and may have been substrate for one egg), Rosita, Custer Co. Colo., July 26, 1970. I searched for eggs at Coal Creek, Jefferson Co. Colo., July 9, 10, 15, 16, 17, 1991, and N fork Clear Creek, Gilpin Co. Colo., July 11, 18, 29, 1991, but no eggs found. B. tricholepis is common in montane S Colo., so is likely to be an important host there. Oryzopsis exigua is the commonest grass at the Jefferson Co. sites, and it is tempting to assume that it is a hostplant, but there is no data except one preoviposition on O. exigua at Tinytown, Jefferson Co. Colo., and this grass is shunned by all other butterflies. Before ovipositing the females hover over the grass, flying back and forth about 20 cm above the grass before landing and ovipositing (Scott 1974a reports movements and behavior). EGG cream, developing a red ring. FIRST-STAGE LARVA cream; head blackish-brown.

Poanes zabulon taxiles (Edw.). Oviposition Glyceria striata (previously

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 misidentified as Puccinellia airoides [B1], Green Mtn., Jefferson Co. Colo., July 11, 1972. Oviposition Agropyron (Pascopyrum) smithii var. molle (W), Fort Collins, Larimer Co. Colo., June 28, 1977. Oviposition 10:02 on underside of Agropyron (Elymus) canadensis (W) leaf, Chimney Gulch, Jefferson Co. Colo., July 10, 1978. Oviposition 14:15 on Dactylis glomerata (W), Chimney Gulch, Jefferson Co. Colo., July 17, 1978. Oviposition 10:45 on underside of leaf of Agropyron (Elytrigia) repens X Agropyron (Elymus) trachycaulum (lemma slightly pubescent, but a rhizome seen so perhaps a hybrid), Falcon County Park, Jefferson Co. Colo., July 14, 1984. Oviposition 10:44 on underside of leaf of Agrostis gigantea Roth (W), Tucker Gulch (Golden Gate Can.), Jefferson Co. Colo., July 18, 1984. Oviposition 10:20 (reared to pupa) on underside of Agropyron (Elymus) canadensis (W) leaf, Falcon County Park, Jefferson Co. Colo., July 28, 1984. Oviposition 12:32 on Agrostis gigantea, LaPorte, Larimer Co. Colo., July 9, 1986. Oviposition 14:14 on underside of 4-mm-wide Agrostis gigantea leaf, Wheatridge, Jefferson Co. Colo., July 7, 1988. 1 egg found on underside of Dactylis glomerata leaf, 1 egg found on underside of Agropyron (Elytrigia) repens leaf, Wheatridge, Jefferson Co. Colo., July 8, 1988. Egg found on underside of Agropyron (Elytrigia) repens leaf, Wheatridge, Jefferson Co. Colo., July 11, 1988. Egg found on underside of Agropyron (Elytrigia) repens leaf, egg found on underside of Phalaris (Phalaroides) arundinacea leaf, Wheatridge, Jefferson Co. Colo., July 13, 1988. Oviposition 13:04 on edge of young leaf growing from node, 2 eggs found on underside of leaves, 1 egg found on top of leaf, all on Phalaris (Phalaroides) arundinacea, Wheatridge, Jefferson Co. Colo., July 15, 1988. 2 eggs (laid separately, hatched at different times) found on underside of Agropyron cristatum desertorum leaf, Lakewood, Jefferson Co. Colo., July 20, 1988. 1 larva in nest of three Dactylis glomerata leaves silked together for 2.5 cm, Wheatridge, Jefferson Co. Colo., Aug. 12, 1988. 1 larva (head width 1.7 mm) found in silk nest (leaf curled upward into a tube) in Phalaris (Phalaroides) arundinacea leaf, Wheatridge, Jefferson Co. Colo., Aug. 22, 1988. 1 empty larval nest found on Festuca arundinacea (probably taxiles, an empty tube with ~6 silk cords connecting the leaf edges upward, and next to it two long leaves were silked together, this type of nest is made by taxiles but not by Piruna pirus), Wheatridge, Jefferson Co. Colo., Aug. 29, 1988. 3 empty leaf nests (probably taxiles, possibly Ochloides sylvanoides) found on Agrostis gigantea, Chimney Gulch, Jefferson Co. Colo., Aug. 30, 1988. 1 larva (head width 1.5 mm) found in rolled leaf nest on Agropyron (Elymus) canadensis, Falcon County Park, Jefferson Co. Colo., Aug. 30, 1988. 2 larvae (head widths 1.7, 1.8 mm) found in Agropyron (Elytrigia) repens leaf nests (one in 3 small leaves silked together, other in one large leaf bent double), 1 larva (head width 1.8 mm) found in Phleum pratense leaf nest (2 leaves silked together), Red Rocks, Jefferson Co. Colo., Sept. 1, 1988. 1 larva (head width 1.7 mm) found in Agropyron (Elytrigia) repens leaf nest (a rolled leaf), Red Rocks, Jefferson Co. Colo., Sept. 2, 1988. One 12-mm-long larva (head width 1.2 mm) found in Agrostis gigantea leaf nest (two overlapping leaves silked together), Apex Gulch, Jefferson Co. Colo., Sept. 7, 1988. 1 empty nest of 4 Bromus (Bromopsis) inermis leaves silked together (probably taxiles, possibly Ochloides sylvanoides) found, Wheatridge, Jefferson Co. Colo., Oct. 1, 1988. 2 empty larval nests (probably taxiles, possibly Ochloides sylvanoides, 3 terminal leaves silked into tube, leaves eaten beyond nest) found in Bromus (Bromopsis) inermis, 2 empty larval nests (probably taxiles, possibly Ochloides sylvanoides) found in Calamagrostis canadensis, 1 empty larval nest (leaf constricted almost to midrib 40 mm basal to tube, so perhaps Piruna pirus) found in Phalaris (Phalaroides) arundinacea, Wheatridge, Jefferson Co. Colo., Oct. 3, 1988. 1 empty larval nest (probably taxiles, possibly Ochloides sylvanoides, leaf rolled into tube with silk mat all over inside and edges also fastened with ~10 silk cords 1-3 mm in length) found on Phalaris (Phalaroides) arundinacea, 2 empty larval nests (probably taxiles, possibly Ochloides sylvanoides) and 1 larva (head width 2.1 mm) found in silked leaf tube (the larval nest of two green leaves and one dead leaf fastened with silk mat and ~5 tiny silk cords, the larva 13.5 mm long the head 2.0 mm wide so ~4th stage, larva voided 2 pellets so was still feeding on this date) on Bromus (Bromopsis) inermis, Wheatridge, Jefferson Co. Colo., Oct. 4, 1988. 3 empty larval nests (probably taxiles, possibly Ochloides sylvanoides) found on Bromus (Bromopsis) inermis, Mt. Vernon Historic Site, Jefferson Co. Colo., Oct. 7, 1988. 1 larva (12 mm long with head 2.0 mm wide) in silked tube made from 1 leaf & 1 stem of Agrostis gigantea plant and 1 leaf of another A. gigantea, 1 empty larval nest (2 green leaves silked together) (probably taxiles, possibly Ochloides sylvanoides) found on top of Muhlenbergia racemosa (Michx.) B.S.P., Tucker Gulch, Jefferson Co. Colo., Oct. 10, 1988. 1 empty larval nest (2 leaves silked together for 30 mm) (probably taxiles, possibly Ochloides sylvanoides) on upper part of Agrostis gigantea, Mother Cabrini Shrine,

Jefferson Co. Colo., Oct. 11, 1988. 1 empty larval nest found on Phalaris (Phalaroides) arundinacea, the nest 2 leaves silked together and both leaves eaten to midrib above nest (the size of the nest and construction seems to indicate that the nest was probably taxiles, possibly Ochloides sylvanoides, and not Piruna pirus), Wheatridge, Jefferson Co. Colo., Oct. 14, 1988. 1 empty larval nest (1 green and 2 dead leaves silked into tube) (probably taxiles, possibly O. sylvanoides) on Agropyron (Elytrigia) repens, Red Rocks, Jefferson Co. Colo., Oct. 18, 1988. 2 eggs found on Agrostis gigantea leaf underside, 3 eggs found on Phleum pratense leaf underside, 1 egg found on Bromus (Bromopsis) lanatipes leaf underside, Tucker Gulch, Jefferson Co. Colo., July 13, 1989. 12 eggs found on Muhlenbergia racemosa, 2 eggs found on Agropyron (Elytrigia) repens, 3 eggs found on Agrostis gigantea, (2 empty nests of 3 A. gigantea leaves tied together could have been taxiles or Ochloides sylvanoides), all on leaf undersides, Apex Gulch, Jefferson Co. Colo., July 15, 1989. 2 eggs found on Dactylis glomerata, 5 eggs found on Agrostis gigantea, 1 egg found on Agropyron intermedium, 1 egg found on Glyceria striata, Chimney Gulch, Jefferson Co. Colo., July 16, 1989. 1 egg found on Muhlenbergia racemosa, 5 eggs found on Agrostis gigantea, 25 eggs found on Glyceria striata, Apex Gulch, Jefferson Co. Colo., July 17, 1989. 2 eggs found on Agrostis gigantea leaves, 8 eggs found on Glyceria striata leaves, (2 empty nests of 3 leaves made by one larva on Agropyron [Elytrigia] repens could have been made by Ochloides sylvanoides or by taxiles), Apex Gulch, Jefferson Co. Colo., July 18, 1989. Empty eggshell and a nearby 1st-stage larva found, the larva in 4-mm-wide leaf curved upward and sides connected by 25 cords of multistrand silk (each cord made by a circular back-and-forth motion of head), no mat spun on leaf surface (older larvae do spin a silk mat on top leaf surface inside leaf tube), both on Agropyron (Leymus) ambiguus, Tucker Gulch, Jefferson Co. Colo., July 27, 1989. 1st-stage larva found on Agrostis gigantea (nest had 8 silk cords tying leaf upward), 1 egg found on Glyceria striata leaf underside, Tucker Gulch, Jefferson Co. Colo., July 31, 1989. 1 ~3rd-stage larva found in silked-leaf tube on Echinochloa crus-galli var. mitis, 1 empty larval nest (probably taxiles) on Glyceria striata, S Cooley Gravel Quarry, Jefferson Co. Colo., Aug. 10, 1989. 1 ~3rd-stage larva, and 1 dead egg on leaf underside, found on Agropyron (Elymus) canadensis, Green Mtn., Jefferson Co. Colo., Aug. 10, 1989. A 1-cm-long larva found in Agrostis gigantea leaf nest, a 6-mm-long larva found in Agropyron (Elymus) trachycaulum leaf nest (nest 8 cm long, the leaf chewed down to midrib beyond and basal to the 1-cm-long tube containing larva, head facing leaf base--this nest resembles Piruna pirus nest, but larva was reared and proved to be taxiles, though larva died when mature due to fly pupa inside), Apex Gulch, Jefferson Co. Colo., Aug. 24, 1989. 10-mm-long larva (head 1.7 mm wide) found in Glyceria grandis leaf nest (leaf eaten beyond tube, and chewed to midrib for 15 mm basad of tube, larval head facing leaf base), 7-mm-long larva (reared to pupa) found in 4-cm-long rolled-leaf nest on Calamagrostis canadensis, Wheatridge, Jefferson Co. Colo., Aug. 30, 1989. A 12-mm-long larva (head 2.6 mm wide) found in Bromus (Bromopsis) porteri leaf nest, SE Phillipsburg, Jefferson Co. Colo., Aug. 31, 1989. 1 larva 15-mm-long (head 1.7 mm wide) found in silk-leaf nest of Agropyron (Elytrigia) repens, Wheatridge, Jefferson Co. Colo., Sept. 18, 1989. Larva 15-mm-long (head 2.4 mm wide) found in Echinochloa crus-galli var. mitis rolled-leaf nest, S Cooley Gravel Quarry, Jefferson Co. Colo., Sept. 20, 1989. Larva 15-mm-long (head 2.4 mm wide) (with 4-mm-long parasitoid inside) found in silked-leaf nest (two tubes on one leaf with leaf chewed to midrib basal to each tube, another leaf rolled into tube also) on Agropyron (Elymus) canadensis, Falcon County Park, Jefferson Co. Colo., Sept. 20, 1989. Egg found on Agropyron (Elymus) trachycaulum (larva 70 cm above ground on 8-mm-wide leaf, 10 cm from leaf tip); empty egg on A. (E.) trachycaulum (50 cm, 7 mm, 9 cm); egg on A. (E.) trachycaulum (50, 5, 14); egg found A. (E.) trachycaulum (60, 6, 13); egg found Agropyron (Elymus) canadensis (40, 9, 7); egg found Agropyron (Leymus) ambiguus (30, 4, 12); egg found A. (L.) ambiguus (35, 6, 28); all on leaf undersides in gulch or N-facing slope, some in shade and some in mostly sunny spots; Red Rocks, Jefferson Co. Colo., June 30, 1990. Egg found on Agrostis gigantea leaf underside (30 cm above ground on 3-mm-wide leaf, 7 cm from tip); Tucker Gulch, Jefferson Co. Colo., July 1, 1990. 2 eggs found on Bromus (Bromopsis) inermis leaf undersides, shade under spruce tree; preoviposition 15:40; Lakewood, Jefferson Co. Colo., July 6, 1990. 2 eggs found on underside of Agropyron (Elymus) canadensis leaves 7 & 8 mm wide in partial shade; Falcon County Park, Jefferson Co. Colo., July 10, 1990. Egg found on Leersia oryzoides (30-40 cm above ground on 4-mm-wide leaf, 9 cm from leaf tip), in tree shade next to water; Wheatridge, Jefferson Co. Colo., July 14, 1990. Oviposition 11:28 on small Agrostis gigantea (10 cm above ground on 4-mm-wide leaf underside, 4 cm from leaf tip) (sunny 2-3 hr. per day); Wheatridge,

Jefferson Co. Colo., July 26, 1990. Larva 7 mm long found in Muhlenbergia racemosa leaf tube beside creek; Apex Gulch, Jefferson Co. Colo., Aug. 20, 1990. 2 larvae 10, 12 mm long found in Agropyron (Elymus) canadensis leaf tube nests; partly shaded gulches; Tinytown, Jefferson Co. Colo., Aug. 29, 1990. Larva 12 mm long found in Bromus (Bromopsis) inermis leaf tube nest; Tinytown, Jefferson Co. Colo., Aug. 30, 1990. 1 larva 5 mm long, 9 larvae 12-15 mm, found on Agropyron (Elymus) trachycaulum; 2 larvae ~15 mm long found on Agropyron (Leymus) ambiguus; all in fairly sunny gulch, Red Rocks, Jefferson Co. Colo., Sept. 4, 1990. 15-mm-long parasitized larva found in Bromus (Bromopsis) lanatipes leaf tube; 2 empty nests found B. lanatipes; 13-mm-long parasitized larva found in Stipa scribneri nest of several leaves silked together (10 cm above ground) (larvae had been eating this plant), but Agropyron (Elymus) canadensis grew in this clump also and 5 cm from larva was an empty nest 3 cm above ground on A. canadensis; 3 empty nests found on A. canadensis; N Oak Creek Cgd., Fremont Co. Colo., Sept. 11, 1990. Larva 14 mm long found in Dactylis glomerata silked-leaf nest of ~3 leaves; Jarre Can., Douglas Co. Colo., Sept. 18, 1990. 2 larvae and 1 head capsule found in leaf tubes on 3 Sorghastrum nutans (= avenaceum) plants; 1 larva found in nest of 2 S. nutans leaves and 1 Agrostis gigantea leaf; 2 larvae and 2 head capsules found in silked-leaf nests on 4 A. gigantea; 1 larva found in Bromus (Bromopsis) inermis leaf nest; 3 larvae found in silked-leaf tubes on Carex nebraskensis 40-cm-long leaves (the leaves were heavily eaten proving that larvae ate this plant), but ~4 tiny empty larval tubes were found on adjacent Agrostis gigantea, so I think the mother must have laid eggs on A. gigantea, and later the larvae sought a larger nest and crawled onto the C. nebraskensis, thus Carex is only a secondary host; no nests seen on Panicum virgatum, so females evidently reject it; Marshall, Boulder Co. Colo., Sept. 25, 1990. Oviposition 13:15 Bromus (Bromopsis) lanatipes leaf underside, W-facing slope among trees, N fork Clear Creek, Gilpin Co. Colo., July 11, 1991. Larva ~12 mm long found in Bromus (Bromopsis) lanatipes leaf nest, shaded gulch, Tinytown, Jefferson Co. Colo., Sept. 4, 1991. Preovipositing female landed on Andropogon scoparius twice 10:26 but did not oviposit, Coal Creek, Jefferson Co. Colo., July 10, 1991. HOSTPLANTS. I accept all 23 grasses as hostplants, and am not sure that any of them is favored: Agrostis gigantea (39 records), Glyceria striata (37), Muhlenbergia racemosa (15), Agropyron (Elymus) canadensis (14), Bromus (Bromopsis) inermis (13), Agropyron (Elytrigia) repens (12), Phalaris (Phalaroides) arundinacea (9), Agropyron (Elymus) trachycaulum (7), Dactylis glomerata (6), Agropyron (Leymus) ambiguus (6), Bromus (Bromopsis) lanatipes (4), Phleum pratense (4), Sorghastrum nutans (4), Calamagrostis canadensis (3), Echinochloa crusgalli var. mitis (2), Agropyron cristatum desertorum (2), Glyceria grandis (1), Leersia oryzoides (1), Bromus (Bromopsis) porteri (1), Stipa scribneri (1), Agropyron (Pascopyrum) smithii var. molle (1), Agropyron (Elytrigia) intermedium (1), Festuca arundinacea (1, the most poorly-documented host, based on only 1 empty nest). In addition, Carex nebraskensis had 3 records but was probably a secondary host of older larvae. Glyceria striata, Muhlenbergia racemosa, and Phalaris arundinacea have more records than their popularity would indicate because they are not common and I searched them heavily to find immatures of all hay-feeding skippers. Agrostis gigantea, Agropyron (Elymus) canadensis, Bromus (Bromopsis) inermis, Agropyron (Elytrigia) repens, Agropyron (Elymus) trachycaulum, Dactylis glomerata, Agropyron (Leymus) ambiguus, and Bromus (Bromopsis) lanatipes are no doubt popular hosts in nature because they are common plants and grow in valley bottoms, while Phleum pratense is less common so is a less common host. The other hostplants are only occasionally chosen because they are uncommon plants or because they usually do not grow in valley bottoms. Festuca arundinacea has very tough straplike leaves and is no doubt rarely chosen. Evidently any moist-habitat (streamside, gulch bottom, etc.) preferably-shaded tall grass with leaves about 3 mm or wider, either growing in a single stalk (or few stalks) or a clump, is suitable for this species. The hosts are very similar to those of Piruna pirus, Ochloides sylvanoides, and Amblyscirtes vialis. (Hay-feeding skippers differ somewhat in their distribution: P. zabulon taxiles females are almost entirely restricted to valley bottoms in semi-shaded or shaded places, whereas Piruna pirus females mostly stay in valley bottoms but occur on N-facing slopes to some extent, Amblyscirtes vialis occur in valley bottoms in partly sunny areas near lush vegetation, and Ochloides sylvanoides females occur on N-facing slopes including valley bottoms.) In the lab, larvae fed to pupation on Poa pratensis. NESTS: Young larvae roll a leaf upward into a tube; older larvae roll single leaves into a tube if the leaf is very wide, but usually silk several leaves together into a tube. Larvae do not intentionally chew the leaf down to the midrib basal to the larval tube as P. pirus does, although in the course of feeding the leaf is chewed to the midrib sometimes. Most larval nests

found on the upper part of grasses, but this is in part due to greater difficulty of finding nests near the ground. HIBERNATION STAGE: 14 larvae found in late Aug.-Oct. have head widths of 1.5-2.6 mm (one larva 1.2, one 1.5, seven 1.7-1.8, one 2.0, one 2.1, two 2.4, one 2.6); for comparison, 4 pupating larvae had 2.7-3.3 mm head width; thus, if there are 5 stages total, these larvae apparently represent mostly 4th-stage larvae with a few 3rd- and one 5th-stages, so evidently 4th stage larvae hibernate most often, evidently in the silked-leaf-tube larval nest. Head widths of larval stages evidently are: 1st 0.6 mm, 2nd 0.8-0.85, 3rd 1.2-1.5, 4th 1.6-2.4, 5th 2.7-3.3. EARLY STAGES from Colo.: EGG cream-white, hemispherical but with tapered sides, smooth & unribbed. FIRST-STAGE LARVA cream, after feeding insides greenish; collar and head black or red-brown. MATURE LARVA orangish-tan (sometimes greenish-ochre-tan) dorsally (microscopically, cream with brownish mottling), tan on the sides, underside pale-tan, with a brown middorsal band, a small subdorsal brown dot on front of each segment near middorsal band, a weak narrow dorsolateral brown band, a weak but slightly darker supraspiracular brown band, a wide very weak fairly-light brown lateral band containing spiracles (the upper part of this band above spiracles is the darkest), brown dots occur along spiracle line, a light-brown band below lateral bulge, underside uniform pale-tan, prothorax cream with narrow black collar; head brownish-red or orange-brown, with weak pattern (a brown stripe edging coronal sulcus has a faint orangish band beside it, a light orange-brown band runs from just in front of eyes to top of head and contrasts with a brown streak extending up from eyes), head & body covered with short white hair. PUPA head, T1-2, wings, & appendages dark-brown with a bluish-gray glaucous suffusion, orangish-tan on top of T3 and abdomen, pale-tan on underside of abdomen, a brown dot below each of the numerous tan body hairs, a blackish lenslike mark across front of head is constricted then flared laterally next to orbit, orbit red-brown, eye blackish, two blackish subdorsal crescents on top of head, 2 subdorsal transverse blackish dashes on rear of T2, the abdomen with many black transverse dashes and dots (the dashes fewer & longer in middle of each segment, more and small in a line near the rear), an odd orange patch of oval bumps (lenticles?--each has a seta) near each side of the proboscis on A4-6, proboscis orange-brown where it extends 5-mm beyond wings, cremaster red-brown; inside the larval leaf nest, attached only by the cremaster.

Euphyes bimaculata (G. & R.) ("illinois" [Dodgel, a weak ssp. distinguished only by larger size). Larvae (raised in lab from eggs laid by a female from Republican River, Yuma Co. Colo., July 1, 1973) ate various sedges, a larva hibernated and died during 5th-stage (head width 2.2 mm). Adults common in sedge meadow where Carex nebraskensis and Carex simulata are common, Scirpus americanus ("Schoenoplectus pungens") less common, Eleocharis palustris few, Juncus arcticus ater var. vallicola common, Juncus longistylis few, Juncus alpino-articulatus uncommon, near Fort Collins, Larimer Co. Colo., July 12, 1988; Carex is the most likely host. Preoviposition 11:15, she landed on Carex nebraskensis and backed down leaf; oviposition 11:20 Carex nebraskensis (C. nebraskensis and C. simulata common nearby); oviposition 11:22 Carex simulata (C. simulata and C. nebraskensis common nearby, Juncus arcticus ater common nearby); oviposition 11:26 on Carex nebraskensis (C. nebraskensis and C. simulata common nearby); oviposition 11:29 Carex simulata (C. simulata abundant nearby, Carex nebraskensis abundant nearby, Typha latifolia 30-100); oviposition 11:32 Carex simulata (C. simulata abundant nearby, Carex nebraskensis abundant 5-100, Typha latifolia 3-100); oviposition 11:35 Carex simulata (C. simulata abundant nearby, Carex nebraskensis abundant nearby, Scirpus americanus 5, 15, 35-45, 60, Juncus longistylis 80-100); oviposition 11:40 on Carex nebraskensis (C. nebraskensis abundant nearby, Agrostis gigantea 25, 50, Juncus longistylis common, 50, Poa pratensis 30); oviposition 13:37 Carex nebraskensis (C. nebraskensis common nearby, Agrostis gigantea common 10-100, Juncus arcticus ater common 5-100, Scirpus americanus uncommon 15-100); sedge meadow near Fort Collins, Larimer Co. Colo., July 5, 1989. Preoviposition 12:10 on Carex nebraskensis; preoviposition 12:12 Carex nebraskensis; preoviposition 12:20 Carex simulata; oviposition 12:40 on Carex nebraskensis (Carex nebraskensis common on one side 0-100, 0-40 on other side, Juncus arcticus ater very abundant 2-100, Hordeum (Critesion) lubatum 60, 80, Poa pratensis 60, Sphenopholis obtusata 25, S. obtusata and/or Agrostis gigantea [confused identification] common 5-100, Typha latifolia 60); oviposition 12:42 (the same female) Carex nebraskensis (C. nebraskensis abundant 0-100, Scirpus americanus common 10-100, Carex praegracilis common 3-100, Agrostis gigantea common 8-100, Juncus arcticus ater common 20-100, Juncus longistylis? 60); oviposition 13:20 Carex nebraskensis (C. nebraskensis abundant 0-100, Poa pratensis common 5-100, Agrostis gigantea common 5-100, Eleocharis palustris common nearby, Juncus arcticus ater common nearby, Juncus alpino-articulatus one nearby, Carex

158 simulata 20, 25, common 60-100); in sward of Carex nebraskensis/Poa pratensis/Agrostis gigantea/Juncus-or-Eleocharis; oviposition 13:58 Carex nebraskensis (C. nebraskensis abundant 0-100, Scirpus americanus uncommon 5-onward, Poa pratensis fairly common 2-100, Hordeum jubatum 100, Agrostis gigantea 60-80, 70, Juncus alpino-articulatus very abundant nearby-100); oviposition 14:14 Carex nebraskensis (C. nebraskensis common 0-100, Agrostis gigantea 40-100, Juncus arcticus ater scattered 15-onward, Carex simulata common 0-100, Juncus longistylis 30-100); oviposition 14:28 Carex nebraskensis (C. nebraskensis 0-100, Scirpus americanus scattered 15-100, Carex simulata very abundant 0-100, Agrostis gigantea 100, Hordeum jubatum 85); sedge meadow near Fort Collins, Larimer Co. Colo., July 9, 1989. Carex nebraskensis is obviously the main host, Carex simulata an occasional host. Larvae were fed C. nebraskensis in lab. To oviposit, a female searches out the Carex hostplants, especially where they grow at the edge of a small (5-10 cm wide) hollow of absent or lower vegetation where the female can get better flight access to the Carex, she then lands, head upward, on a Carex (nearly always C. nebraskensis) leaf 5-15 cm above the mud (the plants are 15-20 cm tall), preferably a leaf that overhangs backward to provide some shade for egg, then she crawls backward down the leaf 2-10 cm until she is only 2-5 cm above the mud, she curves her abdomen beneath and forward to find a good flat leaf surface and she lays the egg, if she does not find a good surface she crawls about a little to try again, after several failed attempts she crawls upward a few cm and flies (this flight often tears the forewing tips as the wingtips hit nearby leaves, explaining the missing forewing tips of most older females). 4th- and 5th stage larvae evidently hibernate in nature, perhaps some 3rd-stage, though lab larvae continue to develop slowly (egg laying to pupation ~16 weeks in lab). Larvae make silked-leaf nests as usual (young larvae make a nest by rolling one leaf, older larvae silk several leaves together for the nest). Egg greenish-cream when laid, soon developing a red ring near base and a small red ring around micropyle, shape less-than-hemispherical in lateral view (the lower corners an acute angle), slightly oval in dorsal view. FIRST-STAGE LARVA cream, soon becoming greenish-cream due to food inside, collar blackish with narrow anterior brown edge, a tiny black sclerite between collar and spiracle, 4 long setae on A10; head red-brown, the narrow rear flange of head black, head width 0.6-.7 mm. 2ND-STAGE LARVA light green, with numerous small setae; head pattern intermediate between 1st-stage and 3rd-stage, head pale brown with a brown band along coronal sulcus, a slight brown streak extends upward from adfrontal sulcus that narrows and ends on top of forehead, a brown streak extends up from eyes to top of head to join its fellow on other side, with numerous small setae, head width 0.9-1.1 mm. 3RD-STAGE LARVA like 5th stage; head width 1.3-1.4 mm. 4TH-STAGE LARVA like 5th stage; head width 1.6-1.8 mm. 5TH-STAGE LARVA light green, collar black, a black polygonal sclerite between collar and spiracle, spiracles black; head like mature larva, head width 2.0-2.4 mm. MATURE LARVA light green (slightly more-yellowish light-green on A1-7), covered with numerous tiny cream setae with black bases, a darker-green heart-band on T2-A9 has a pale green line through its middle on A1-8, intersegmental folds yellow between T3-A7, testes within A6 appear yellowish on either side of middorsal band, suranal plate has long light-red-brown setae along posterior rim, spiracles black, the usual ventral white wax glands present on A7-8, collar black with a middorsal narrow gap, the collar wider ventrally where it incorporates the black polygonal separate sclerite of previous larval stages and is pointed anteroventrally; head cream with red-brown vertical bands and a black forehead oval, the oval formed of a black dash on each side of coronal sulcus, the dash pointed ventrally, below dash a tan area above frontoclypeus, tan beside upper part of frontoclypeus (a red-brown spike, pointed and darkest at top, extends straight dorsally from this tan area almost to level of top of black oval) and gray beside lower part of frontoclypeus, frontoclypeus gray with a vertical brown line down the middle (frontoclypeus dark-gray on lower edge), head brown beside mouthparts, a cream vertical band runs from lower part of face just anterior to eyes dorsally to top of head then curves medially and then runs ventrally between red-brown spike and black dash, a dark-red-brown band (dark-red-brown in most individuals, but blackish-brown in some 3rd-stage to mature larvae) extends from eyes dorsally to top of head then joins coronal sulcus and runs narrowly ventrally to black dash, rear of head cream-gray except for a white patch just behind anterior 5 eyes that barely includes eye #6, two eyes #2 and #6 are smaller than the others, head width 3.0 mm. Older larva similar to Euphyes vestris, but the vestris head has an extra red-brown vertical band around back of head (just in front of rear rim) that tapers upward to join its fellow on other side at coronal sulcus. There are probably 6 larval stages, though 4th- and 5th-stage larvae have rather variable head widths. PUPA overall appearance

head, thorax, & wings blackish (wings greener distally), appendages dark green, abdomen light mottled green with an orange-brown dorsal flush and a dark-green heart-band; cremaster blunt (not protruding), 2 mm wide with 2 lateral thick spines on each side but no crochets. In detailed description, pupa head blackish, orange-brown on ventral part of head of one pupa (above and to side of labrum, on mandible remnants, & labial sclerite, base of proboscis), but on other pupa this area mostly brown (orange-brown only on mandible remnants & labial sclerite & above and to side of labrum, the base of proboscis blackish-green); posterior third of eye orange-brown on one pupa, blackish on other pupa; T1 spiracle orange-brown; on one pupa T1 dark orange-brown, T2 blackish-brown with pale middorsal cleavage line, T3 brown, top of A1 brown, top of A2-4 pale brown, A5-6 pale chestnut-brown, A7-10 dark green, on other pupa T1 blackish, T2 blackish with black middorsal cleavage line, T3 blackish-brown, top of A1 brown, top of A2-4 chestnut-brown, top of A5-7 pale chestnut-brown, A8-9 green; on one pupa basal 2/3 of wings and appendages greenish-brown, outer 1/3 of wings dark-green (turning green at the margin), on other pupa basal 2/3 of wings blackish, outer 1/3 of wings greenish-black (the very margin green), appendages dark-green, proboscis blackish-brown; lateral part of T3-A7 green (A4-6 slightly brownish-green on the posterior margin that overlaps the following segment); A1-8 has wide dark-green heart-line (appearing brown beneath brown areas, green on intersegmental areas); abdomen appears mottled due to an internal subcuticular tangle of creamy apparent-fat deposits; pupa covered with long orange-brown setae except on wings and appendages; A5 and A6 have subventral bump covered with setae, the bump higher on A6; a tuft of subventral setae on A4 & A7-9; proboscis extends 2.5 mm beyond wings (2/3 way through A5); end of abdomen truncated, "cremaster" dark red-brown, very broad (2 mm wide) with long 0.5 mm red-brown straight setae instead of crochets, two non-hooked spines 0.2 mm long on each anteriorly expanded and widened lateral end of cremaster.

Euphyes vestris (Bdv.). Ovipositions 2 eggs laid on Carex pennsylvanica heliophila (B), Red Rocks, Jefferson Co. Colo., July 18, 1973. Oviposition 11:10 C. probably p. heliophila, Golden Gate Can., Jefferson Co. Colo., July 6, 1980. Oviposition 12:30 on C. prob. p. heliophila, Red Rocks, Jefferson Co. Colo., July 11, 1984. Oviposition 14:35 on leaf of C. prob. p. heliophila, Mt. Vernon Historic Site, Jefferson Co. Colo., July 11, 1984. One 5 mm long larva (head width ~1.65 mm, so ~4th stage) found in tube of 4 C. p. heliophila (W) leaves silked together, Van Bibber Creek, Jefferson Co. Colo., Sept. 24, 1987. Preoviposition 13:00 on C. prob. p. heliophila, Falcon County Park, Jefferson Co. Colo., June 12, 1988. Oviposition 11:49 on underside of C. prob. p. heliophila leaf, Red Rocks, Jefferson Co. Colo., July 4, 1988. Oviposition 10:00 Carex geophila Mack. (W), Coal Creek Can., Jefferson Co. Colo., July 11, 1978. Oviposition 11:50 C. geophila (W), Chimney Gulch, Jefferson Co. Colo., July 17, 1978. Egg (green with red ring) found on Carex rossii leaf underside (C. rossii 7, common 20-100, Andropogon [Schizachyrium] scoparius 30-45, 60, 100, Bouteloua [Chondrosium] gracilis 15, 20-40, 65-90, Stipa comata 50, 50, Agropyron [Elymus] elymoides="Sitianion hystrix" 75, 100); W-facing slope in forest, Crawford Gulch, Jefferson Co. Colo., July 5, 1990. Pupa found in nest of 12 Carex rossii leaves, a larval nest of 10-15 leaves & cast larval skin found 10 cm away in same C. rossii clump; N-facing woods clearing, Tinytown, Jefferson Co. Colo., July 2, 1990. Oviposition 13:15 C. rossii leaf top, ridgetop Tinytown, Jefferson Co. Colo., July 2, 1991. The hosts are sedges that grow on hillsides or sloping flats, often above a rock that traps moisture: Carex pennsylvanica heliophila and Carex geophila grow on S-, E-, and W-facing slopes, Carex rossii on N-facing slopes. Part-grown larvae hibernate. EGG pale-green when laid, turning slightly-greenish pale yellow, developing a wide red ring around egg halfway from base to top, and a red spot with pale yellow center on top; the spot is larger with no pale center in 2 Ont. eggs; the red rings are wider than those of Colo. E. bimacula but similar to those of Ont. bimacula. 1ST-STAGE LARVA slightly-yellowish-cream; collar & head black. 4TH-STAGE-MATURE LARVA (Van Bibber Creek) light green with minute green longitudinal streaks (which make larva appear somewhat darker), tan on T2-A1 and A8-9, top of A10 brown, spiracles black, prothorax with narrow black collar and just below it a black triangular sclerite above black spiracle; head cream, a black rectangular oval (rounded dorsally) on lower 1/2 of coronal sulcus, a very narrow brown line along upper part of coronal sulcus, a narrow brown line along adfrontal cleavage line, a brown dorsally-pointed roughly-bell-shaped marking enclosing adfrontal sulci, a vertical brown line extending up middle of frontoclypeus nearly to top, a brown band touches lower 2/3 of adfrontal cleavage line and tapers dorsally almost to level of top of black rectangle (where it ends), a blackish-brown band extends dorsally from mandible base and eyes #3-6 to top of head where it narrows somewhat and curves medially to

coronal sulcus, a blackish-brown band (narrower dorsally) near rear of head extends around head just in front of neck (this band near rear distinguishes larva from Euphyes bimacula). PUPA head & thorax blackish-brown, blending to greenish-brown on last half of T3, wings blackish-brown (outer third dark-brown) with green edges, abdomen pale yellow-green, the top third of A5-8 suffused with brown, the anterior 2/3 of the dorsal half of each A1-4 suffused with blackish, the telescoping posterior third of each A4-6 segment is shiny brown-green, T1 spiracle chitin-brown, proboscis chitin-brown where it extends 3.5 mm beyond wings almost to rear of A6, head and T1 and front of T2 have short setae, A4-7 have many shorter ventral setae directed rearward, A8-10 have long ventral setae directed rearward that hold pupa in place in nest, cremaster not protruding (because A8 & A9 are shortened dorsally, twisting the abdomen tip upward), cremaster consists of a transverse dorsal rim on A10 (~1.9 mm wide with ~22 straight unhooked longer setae 0.5 mm long), above each end of this ridge is a projection with two stout black spines directed backward.

Not-"Amblyscirtes" simius Edw. 15 ovipositions all day (9:03, 9:11, 9:55, 10:14, 10:41, 10:50, 11:03, 11:05, 11:35, 11:45, 12:00, 13:00, 13:18, 13:56, 14:44) on underside of leaves (usually near the edge of the clump) of Bouteloua (Chondrosum) gracilis, and 20 eggs found on B. gracilis, 1 mi. up Bear Creek, Chaffee Co. Colo., June 1969 and June 1970. 3 eggs found on short-leaved Bouteloua gracilis at lower end of slopes, Midway, El Paso Co., Colo., June 8, 1991. Ovipositing females dart back and forth slowly about 30 cm above the grass before landing and laying (Scott 1973a reports movements and behavior). 3 hours searching B. gracilis produced only one empty larval tunnel ~2 cm X ~4 mm in soil, probably belonging to Hesperia; 1 mi. up Bear Creek, Chaffee Co. Colo., Sept. 5, 1990. 1 mature larva, 1 prepupa, 2 pupae found in silked-leaf-tube nests on Bouteloua gracilis, the nests not strictly underground but the lower ends 5-10 mm below ground level deep among tillers, thus lower part of nest is beneath the top of average soil level of clump (soil level is higher upslope of clump than downslope, since this grass is the main soil-holding plant of shortgrass prairie) and nest extends outward about half length of leaves; all grass clumps had ~10-15 leaf tips eaten off near nest indicating larvae eat the equivalent of ~10 whole leaves in spring after unfed first-stage larvae hibernate; nests were located either by noting the many leaves eaten near nest, or by a chance look straight down open nest tube wherein pale pupae are especially visible; a black wasp crawled into then backed out of one larval nest but could not attack larva because larvae rest with heads upward and heads are too strong to bite; S Midway, Pueblo Co. Colo., May 6, 1992. I have never seen an aerial nest (of any Lepidoptera larva) on B. gracilis, therefore every Hesperinae eating it including "Amblyscirtes" simius must live in a soil/litter tunnel (true Amblyscirtes have aerial nests). 1st-stage larvae hibernate evidently unfed; about 50 1st-stage larvae diapaused and died in the lab (except 1 that died in 2nd stage). A. simius nests cannot be found in Sept. because the species has one generation per year and 1st-stage larvae diapause from July to April, then larvae only feed April-June. EGG slightly-yellowish-cream when laid, but after 2-3 days developing a red ring around egg and a second small red ring around top (other Amblyscirtes lack red rings); hemispherical, with a definite flange extending outward at base (like that of Hesperia comma, and much larger than any true Amblyscirtes). 1ST-STAGE LARVA yellow-cream; collar & head black. MATURE LARVA light-(slightly-yellowish)-blue-green including A10, heart dark-blue-green (weak on T1-3), collar green (with a long transverse staple-shaped [points projecting forward] shallow groove lying behind a row of hairs), true legs tan-green at base and chitin-brown at tip, anal comb above anus has shallow teeth; head has a tan-brown stripe beside coronal sulcus (joining its twin on other side dorsally), a tan strip beside that line, that strip edged by a tan-brown vertical band extending down to middle of adfrontal cleavage line and this band forms the medial edge of rest of side of head which is slightly paler tan-brown (a little darker than the tan stripe due to darker pits) except ventral part of head (at level of labrum and mandibles) is tan, tan lower part of coronal sulcus and tan adfrontal areas, a dark-brown adfrontal sulcus line and dark-brown adfrontal cleavage line, frontoclypeus tan with a slightly-brown vertical line down middle, a blackish-brown transverse line on lower edge of frontoclypeus, labrum translucent-tan, cutting edge of mandibles black, fangs ABSENT. Waxy powder was not noticed on larvae or pupae, and is absent on so larvae evidently lack waxy powder (intersegmental areas on A6-7 and A7-8 are whiter-blue-green but those on A1-6 are a bit whiter also). PREPUPA same as larva but yellowish-bluish-green, A10 slightly-brown due to lots of setae, head greenish-tan. PUPA tan-cream on head thorax and wings, abdomen cream (later maybe a bit yellow-cream), heart-band light-brown on A4-7, T1 spiracle red-brown (other spiracles cream), antenna club tip becomes red-brown, proboscis orange-

beyond cremaster, the orangish-tan cremaster is dorsoventrally compressed and then curved so that tip is aimed ventrally, cremaster tip is tapered to a point (with 1-2 lateral shoulders) without crochets, A5-10 has many backward-directed hairs especially dorsally on curve of cremaster; as adult develops within pupa, eyes appear brown then blacker, wings become ochre-cream, thorax brown, front of T2 and rear of T1 dark-brown. Obviously this species does not belong to Amblyscirtes, because of numerous differences: in simius adults mate on hilltops (versus gulches in true Amblyscirtes) during only part of the day (vs. all day in proper weather), the male aedeagus and saccus are shorter (vs. very long), aedeagus has 2 cornuti (vs. none), uncus tips not connected to gnathos tips (connected), female lamella and ductus bursa rather membranous (vs. well-sclerotized), egg develops red rings (vs. no rings), 3rd palp segment shorter and directed more anteriorly (vs. longer and nearly vertical), hostplant a narrow-leaf turfgrass (vs. broad-leaf hay- or hay-bunch grasses), larval nest in soil and lower part of leaves (vs. completely above ground among leaves), larval head lacks fangs (vs. dracula fangs), mature larval collar green (vs. black), side of mature larval head unstriped light brown (vs. pale with reddish-brown vertical stripes), mature larva lacks waxy powder (vs. powder), pupal cremaster extends ventrally and lacks crochets (vs. posteriorly with crochets). Burns (1990) discussed adult morphological traits, but could not find the proper genus for simius.

Amblyscirtes. Larvae of all species of true Amblyscirtes seem to need dry humidity: when fed the moist grass Poa pratensis, 1st- & 2nd-stage A. vialis and oslari larvae die (the only Hesperini I have raised that failed to thrive on this grass) (though I once reared A. aenus on P. pratensis), and mature larvae easily catch a fungus disease causing the true leg tips to rot away. Based on this and the ranges of most species, the genus obviously evolved in the Mexican-SW U.S. deserts. 2 fangs occur on larval heads of all true Amblyscirtes below the ventral end of the adfrontal sulcus; each fang extends forward slightly then curves downward to a point. Observations of A. aenus & phylace larvae show that fangs function to puncture nest intruders when the head is banged up and down, or to crush & tear nest intruders when the head is scraped violently from side to side. Older larvae are rather acrobatic, sometimes hanging upside down from the A10 prolegs, and are occasionally found exposed in nature in daytime (a very rare occurrence in Hesperiniidae); evidently their ability to defend themselves allows them to leave the nest, perhaps a useful behavior to locate the green leaves of desert grasses (A. oslari larvae must move to other plants occasionally because of the small size of its host, while A. phylace seldom needs to move because its host is so large).

Amblyscirtes vialis. Oviposition 9:31, she landed on Agropyron (Elytrigia) repens once, landed Bromus (Bromopsis) inermis twice and bent abdomen once, landed on B. inermis leaf top and crawled sideways to rest upside down under horizontal portion of leaf and laid an egg on leaf underside (~67 cm above ground on leaf 6 mm wide ~9 cm from leaf tip), this was on sunny valley bottom (B. inermis 0-100, Poa agassizensis 35-100, Agropyron [Elytrigia] repens 40, 80-100); egg found on Bromus (Bromopsis) lanatipes leaf underside (44 cm above ground on 4.5-mm-wide leaf, 7 cm from leaf tip), on lower S-facing slope (B. lanatipes 0-100, Carex probably pennsylvanica heliophila 50, 100); egg found on horizontal leaf underside of young tiny Bromus (Bromopsis) inermis (16 cm above ground on 6-mm-wide leaf, ~7 cm from leaf tip), lower N-facing slope in little clearing in partial shade (B. inermis 20, 20, 25, 30, 50-80, Oryzopsis asperifolia 30, 35, 45, 45, 55, 90, 100, 100, Carex rossii 100); many A. (E.) repens, many Dactylis glomerata, some Phleum pratense, one Agropyron (Leymus) ambiguus, ~5 Agropyron (Elymus) canadensis, many B. inermis, many B. lanatipes were searched; Tinytown, Jefferson Co. Colo., June 26, 1990. Egg found on horizontal Bromus (Bromopsis) lanatipes leaf underside (16 cm above ground on 6.5-mm-wide leaf, 9.5 cm from leaf tip), in little clearing in valley bottom (B. lanatipes 5, 20, 30, 35, etc. common to 100, Poa pratensis common 3-100); egg found on horizontal Agropyron (Elymus) trachycaulum leaf underside (44 cm above ground on 4-mm-wide leaf, 10 cm from leaf tip), on mostly-sunny bank of tiny gulch (A. (E.) trachycaulum 10-100, B. lanatipes 7, 30, 30, etc. common, P. pratensis 5-100 common, Agrostis gigantea 35-50, 100); Tinytown, Jefferson Co. Colo., June 27, 1990. Egg found on Phleum pratense horizontal leaf underside (30 cm above ground on leaf 5.5 mm wide, 14 cm from leaf tip), in bottom of gulch shaded only in morning (P. pratense common 5-15, 30-100, Poa pratensis scattered 7-100, Poa compressa 5, 7, 10-20, small plants common to 100); egg found on horizontal Bromus (Bromopsis) inermis leaf underside (60 cm above ground on leaf 8 mm wide, 9 cm from leaf tip), on E-facing gulch bank (B. inermis 60, 20-100, Agropyron [Elymus] trachycaulum common 25 cm onward, Poa

compressa 80, 90, *Poa pratensis* 80-100); egg found on *Bromus* (*Bromopsis*) *lanatipes* horizontal leaf underside (50 cm above ground on leaf 5 mm wide, 6 cm from leaf tip) on W-facing gulch bank (*B. lanatipes* 0-100); egg found on *Agropyron* (*Elymus*) *canadensis* on dorsal side of leaf but leaf was twisted so egg was facing downward (40 cm above ground on leaf 6 mm wide, 7 cm from leaf tip), on top of W-facing bank (*A. [E.] canadensis* 0-100, *Agrostis gigantea* 100); egg found on *Agropyron* (*Elymus*) *canadensis* horizontal leaf underside (40 cm above ground on leaf 7 mm wide, 6 cm from leaf tip), on top of W-facing bank (*A. [E.] canadensis* 0-100); searched for eggs were ~50 *Dactylis glomerata*, some *Agropyron* (*Elymus*) *glaucus* Buckley, some *Phleum pratense*, few *Oryzopsis asperifolia*, some *Bromus* (*Bromopsis*) *inermis*, some *Bromus* (*Bromopsis*) *lanatipes*, some *Agrostis gigantea*, few *Muhlenbergia racemosa*, few *Andropogon* (*Schizachyrium*) *scoparius*; Tinytown, Jefferson Co. Colo., June 28, 1990. Egg found on *Bromus* (*Bromopsis*) *lanatipes* leaf underside (30 cm above ground on 6-mm-wide leaf, 12 cm from leaf tip), mostly-sunny bench just E of small gulch bottom 2 m; many *B. lanatipes*, ~50 *Dactylis glomerata*, a few *Phleum pratense*, some *Agropyron* (*Elymus*) *trachycaulum*, ~10 *Calamagrostis purpurascens*, 1 *Danthonia parryi*, & 1-2 *Oryzopsis asperifolia*, were searched for eggs; Tinytown, Jefferson Co. Colo., July 2, 1990. One 1-cm-long 3rd-stage larva found in silk nest of *Agropyron* (*Elymus*) *canadensis* leaf tied upward with 8 silk ties (larva on top of leaf) (*Festuca pratensis*, *Phleum pratense*, *Dactylis glomerata* also within 1 m), larva reared through two molts in lab before it died as 5th stage; gulch bottom in Apex Gulch, Jefferson Co. Colo., July 15, 1989. 7 larvae (1 healthy larva 20 mm long, 3 sick or parasitized larvae 12, 12, & 13 mm long, 3 dead shriveled larvae 7, 10, & 12 mm long) were found in rolled-leaf tubes on *Agropyron* (*Elymus*) *canadensis*; the long-occupied leaf nest seems to consist of a rolled leaf tube, the leaf eaten beyond nest, and the leaf chewed nearly to midrib for 2-3 mm just basal to nest (one young-larval nest had the chewed truncated leaf end folded back, and some leaves merely had the ends truncated or chewed down to the midrib), nearly-mature larvae make nests on ~3 leaves of the plant, and nearby plants have nests also, so larvae on smaller plants wander to several plants like *A. osleri* and some *A. phyllace*; all in partially-shaded small gulches (in gulch bottom or on W- or E-facing gulch banks/benches); Tinytown, Jefferson Co. Colo., Aug. 29, 1990. Mature larva found on *Agropyron* (*Elymus*) *trachycaulum*, in uppermost leaf of plant in leaf tube closed with 4 silk ropes, leaf eaten completely beyond nest and eaten mostly to midrib for 2 cm basal of nest, a leaf lower down was fully eaten except for basal 2 cm but 2 basal leaves were untouched, ~15-20 cm² of leaves must be eaten by larva in its lifetime; partially shaded gulch bottom, Tinytown, Jefferson Co. Colo., Sept. 6, 1990. Empty silk-tube nest of 3 leaves (record ignored, because larva was *A. vialis* or *Poaes zabulon taxiles* or *Ochloides sylvanoides*) found on *Festuca arundinacea*; Tinytown, Jefferson Co. Colo., Aug. 29, 1990. Oviposition 12:15 under horizontal spot of drooping *Agropyron* (*Elymus*) *canadensis* leaf (leaf 7 mm wide, egg 9 cm from leaf tip, ~20 cm above ground), sunny area of tiny wooded gulch, Tinytown, Jefferson Co. Colo., May 21, 1992. Egg found on underside of drooping *Agropyron* (*Elymus*) *canadensis* leaf where it was horizontal (leaf 7 mm wide at egg, ~25 cm above ground), part-shaded little gulch, Tinytown, Jefferson Co. Colo., June 11, 1992. Oviposition 12:15 on underside of horizontal portion of drooping *A. (Elymus) canadensis* (egg 9 cm from tip of 7-mm-wide leaf, ~20 cm above ground), small woodland gulch, Tinytown, Jefferson Co. Colo., May 21, 1992. HOSTPLANTS. Obviously hay grasses are the hostplants, including *Agropyron* (*Elymus*) *canadensis* (11 records), *Bromus* (*Bromopsis*) *lanatipes* (4), *Bromus* (*Bromopsis*) *inermis* (3), *Agropyron* (*Elymus*) *trachycaulum* (2), *Phleum pratense* (1); no doubt others are eaten as well (*A. vialis* is not as common as the other hay feeders so I do not have as much data; I have about 15 or more hay grasses recorded for the common hay feeders). 1st-2nd-stage larvae died feeding on *Poa pratensis*. *Agrostis gigantea* is probably usually refused because the leaves are mostly vertical and females evidently prefer to oviposit beneath horizontal portions of the leaf; it grows in wet soil also and females evidently seldom lay in wet areas. Many *Dactylis glomerata* were searched with no results; perhaps the leaves are too succulent for *A. vialis*. Eggs are laid an average of 40 cm above ground, on leaves 6 mm wide, 9 cm from leaf tip, all on underside of the horizontal portion of the drooping leaf (except one egg that faced to the side and slightly downward on a leaf angled downward). NEST. Mature larvae usually chew the leaf nearly to midrib for 2-3 mm just basal to rolled leaf nest, and eat the leaf beyond nest. Mature fully-fed larvae hibernate. EGG slightly-translucent white, turning slightly cream after a few days, with faint little polygons on surface, hemispherical in lateral view (cross-section of lower edge slightly more acute than a right angle but slightly rounded), the very top flat with a slightly sunken circle, with a dark spot on the micropyle

area that seems to move as the egg is tilted (like the phantom dark spot on eggs of Ochlodes sylvanoides, Poanes, etc.). (In contrast, Piruna pirus eggs are hemispherical in lateral view, with faint vertical ribs, the center of top is sunken more, into a platelike area; and Poanes zabulon taxiles eggs are very smooth without polygons, the lower edge more rounded, the top flattened but not indented.) 1ST-STAGE-LARVA yellow-cream, after feeding turning light-bluish-yellow-green, collar black, A10 has 2 long setae; head black, conical in front view (the top pointed, much more triangular than the other hay-feeders Poanes, Ochlodes, Piruna, etc.). 2ND-STAGE LARVA head black. 3RD-STAGE LARVA (1 cm long) whitish-green, heart-band darker-green, the narrow black collar ending just above large black spiracle; head dark-brown without stripes, narrowed dorsally in anterior view, the fang represented by only a small bump, head 1.1 mm wide. 4TH-STAGE LARVA pale bluish-green covered with tiny white specks, a middorsal dark blue-green heart-line, T1 collar extending laterally to just above T1 spiracle and whitish on front 40% and black on rear part; head fang short (half the length of mature fang) and rapidly tapered near the tip, color varies between individuals: head mostly black except for a pale area behind eyes; OR head black with glaucous bloom and faint light stripes like those of mature larva; OR head black with orange-brown stripes almost as large as mature larval bands but lateral pale stripe mostly divided in two by a brownish area at about the level of top of frontoclypeus; OR head dark orange-brown and covered with a whitish bloom, the rear rim blackish, a blacker inverted-Y-shaped mark on coronal-adfrontal sulcus, coronal sulcus slightly paler. MATURE LARVA (Table 9) whitish-bluish-green, heart-band gray (slightly-bluish-green), collar narrow & black; head glaucous (with a whitish bloom caused by numerous long flattened pale hairs [which appear under microscope as chitin-tan with translucent whitish margins] covering head & body [other Amblyscirtes lack this head frosting--these hairs in A. oslari for instance are 1/3 as long and appear translucent under microscope])--cream with orange-brown stripes (a wide orange-brown or blackish-orange-brown band [tapered near rear rim] on coronal sulcus which extends down as an orange-brown or dark-orange-brown edging of adfrontal cleavage line to red-brown fang, an orange-brown or dark-orange-brown vertical spike extends upward from there [directly above fang] to just above level of top of frontoclypeus, a broad orange-brown or dark-red-brown [often blackish-brown near eyes] band extends upward from eyes then curves onto top of head almost to coronal band, rear rim of head broadly blackish-chestnut-brown or black, an inverted blackish or black wishbone-shaped mark is on adfrontal sulci and on that portion of coronal sulcus below adfrontal cleavage line, frontoclypeus completely filled with orange-brown on 2 larvae, filled with blackish-orange-brown on ventral half on 1 larva, filled with orange-brown only on lower edge [plus a vertical orange-brown band to top] on one larva, anteclypeus blackish-orange-brown), head has tiny polygonal pits seemingly different from Ochlodes sylvanoides. PUPA unknown in Colo., but must be similar to other Amblyscirtes, because described in E U.S. as green, head slightly reddish, proboscis reddish beyond wing cases.

Amblyscirtes aenus aenus Edw. 1 nearly-mature larva ~22 mm long found on Agropyron (Leymus) ambiguus, the larva was resting exposed on a leaf several cm from two empty silked-leaf tube nests (both of 2 leaves, the leaves eaten basal and distal to tube, one nest had one leaf chewed to midrib on distal part of tube, other nest had leaf chewed to midrib basal to tube), larva fed on Poa pratensis in lab for a week then diapaused as a mature larva, which was refrigerated for 2 months, then removed from refrigerator but died; N-facing slope on Beaver Brook Trail, Jefferson Co. Colo., Aug. 28, 1989. A female of form erna F. (the unh unspotted) from Furnish Can., Baca Co. Colo., laid eggs in the lab, and the larvae were raised on Poa pratensis, producing two male offspring of the normal spotted-unh form of aenus (thus demonstrating the conspecificity of erna and aenus, Scott 1977). Mature fully-fed larvae hibernate. 5TH-STAGE MATURE LARVA (Table 9) light whitish-green (turning cream in color after hibernation started), heart gray-green, a faint lateral pale-green band, ventral side of A7-8 with usual waxy-white-powder glands, the narrow collar extends laterally to just above spiracle, the front half of collar chitin-colored, the rear part narrowly black; head cream with orange-brown bands (a narrow vertical orange-brown band on frontoclypeus, a narrow orange-brown band along adfrontal sulcus and extending upward along coronal sulcus a bit, a wider orange-brown band along adfrontal cleavage line [very narrow near coronal sulcus] which is joined to a broad orange-brown band along coronal sulcus, a narrow orange-brown spikelike band extends upward ~0.5 mm from upper part of adfrontal cleavage line band to parallel the broad coronal sulcus band, a broad orange-brown band extends upward from anterior four eyes to join broad coronal-sulcus band on top of head, rear rim of head orange-brown (blackish beside

164 neck), head 2.3 mm wide, sculptured with tiny polygonal pits, the head with a fixed red-brown chitin fang extending forward and down just above each lateral edge of labrum. The fangs are surely used for defense against intruders into the hibernial nest. I opened the mature larval nest once with tweezers and the larva banged its head up and down quickly a few times, evidently to puncture the intruder with its fangs. Another time I opened the end of its nest with tweezers and the larva scraped its head violently around the nest opening 3 times by turning head to right then to left etc. (the head twisting $\sim 90^\circ$), which would scrape and tear a small intruder. Older larvae may also use the fangs to help bring leaves close to make a nest, because I once saw the mature larva hanging from a leaf with only the A10 prolegs, holding a leaf with its legs to eat, and once saw the larva hanging from silk on the glass jar from only the A10 prolegs to grasp a leaf; while the larva is making this acrobatic hanging from A10 prolegs, the fangs could hook over the edge of a leaf to bring it within grasp of the true legs (but this behavior has never been observed). PUPA (3 pupal shells, Furnish Can.) proboscis extends to base of cremaster, T1 spiracle tan, front of head slightly tan, most of shells translucent, implying that colors are similar to those of A. oslari, a supraventral slight hill on A4,5,6 contains large oval lenticles.

Amblyscirtes oslari. Oviposition 13:18 on leaf underside of small Bouteloua curtipendula 10 cm long in a line of these plants at the top edge of a small (50 cm wide) bare hollow of slope (B. curtipendula 1-45, Andropogon gerardii 100, Bromus (Anisantha) tectorum 5, 15-100, Stipa comata 15-100); egg found (33 cm from first egg) on B. curtipendula (B. curtipendula 0-60, Stipa comata 15-30, Bromus tectorum 15-100, Sporobolus cryptandrus 45); egg found (45 cm from first egg) on B. curtipendula (B. curtipendula 0-70, Stipa comata 10 cm onward, Bromus tectorum 5 cm onward); many Andropogon gerardii, many Bouteloua (Chondrosium) gracilis, some Andropogon (Schizachyrium) scoparius, and some B. curtipendula & a few others were searched, proving that B. curtipendula is the favorite host; Apex Gulch, Jefferson Co. Colo., June 4, 1990. Preoviposition 13:00; egg found on B. curtipendula leaf underside, at top of steep small bare ground (B. curtipendula 0-100, Stipa comata 25-50, Carex probably pennsylvanica heliophila 30-100, Andropogon (Schizachyrium) scoparius 100, Koeleria macrantha 100, Bromus tectorum 80); 2 eggs found 1 cm from each other on B. curtipendula leaf underside in slight hollow of slope (B. curtipendula 0-50, 80-100, Stipa comata 15, 25, 40 cm onward, Bromus tectorum scattered 15-100, Sporobolus cryptandrus 90-100, Carex probably pennsylvanica heliophila 60); egg found B. curtipendula in hollow below rock pile (B. curtipendula scattered 0-90, Stipa comata common 25 cm onward, Bromus tectorum 15, 30 cm onward, Sporobolus cryptandrus 100, Andropogon gerardii 100); egg found B. curtipendula in part-shade in small hollow of slope (B. curtipendula 7, 12, 30-100, Stipa comata common 10 cm onward, Agropyron [Pascopyrum] smithii 15-20, 35-100, Bromus tectorum 65-70); egg found B. curtipendula on slight hollow of slope (B. curtipendula 0-100, Stipa comata 15, 25, common 40 cm onward, Sporobolus cryptandrus 90-100, Aristida purpurea 100); egg found B. curtipendula beside low spot of slope (B. curtipendula 0-40, 60-70, Agropyron [Pascopyrum] smithii 50-80, Stipa comata 30-45 etc. common, Andropogon (Schizachyrium) scoparius 80-100); egg found B. curtipendula in little low spot of slope (B. curtipendula 5-20, 30, 50-100, Bromus tectorum 8, 15-20, scattered to 100, Stipa comata 10, 15, 20, etc. common, Andropogon gerardii 70-100, Carex probably pennsylvanica heliophila 50-100, Sporobolus cryptandrus 80); egg found B. curtipendula in little clearing of slope (B. curtipendula 0-80, Stipa comata 80, 90, Agropyron [Pascopyrum] smithii 40-100, Carex probably pennsylvanica heliophila common 25 cm onward, Andropogon (Schiz.) scoparius 30-100, Bromus tectorum 5, 10, 20, 30, etc. scattered); egg found B. curtipendula (B. curtipendula 0-25, 40-50, 60, Agropyron [Pascopyrum] smithii 60-100, Carex probably pennsylvanica heliophila 5-35, 50-90, Andropogon [Schiz.] scoparius 30-100, Andropogon gerardii 80, 100, Stipa comata 100, Bromus tectorum 20, 90); some B. curtipendula, a few Bouteloua gracilis, many Andropogon (Schiz.) scoparius, and some Andropogon gerardii were also searched; obviously B. curtipendula is the preferred host; Apex Gulch, Jefferson Co. Colo., June 5, 1990. 1 larva 20 mm long found in B. curtipendula leaf tube of ~5 leaves, near ~4 short empty leaf tubes; 3 other B. curtipendula plants had empty tubes; S-facing slope, Apex Gulch, Jefferson Co. Colo., Aug. 20, 1990. Mature larva found in B. curtipendula leaf tube, reared to adult, 3 empty tubes found on plant; hilltop Bear Creek, Chaffee Co. Colo., Aug. 21, 1990. Larva 2.5 cm long (head upward) found on Andropogon gerardii, 10 cm from 2 fresh empty nests on B. curtipendula, so larva moved onto A. gerardii after feeding most of its life on B. curtipendula; Apex Gulch, Jefferson Co. Colo., Aug. 23, 1990. Near-mature larva found on Stipa comata (which showed no feeding damage so is not a host) resting in the open 4, 8, 25, 30 cm from large leaf tubes on B.

~4th stage ~13 mm long found in B. curtipendula silked-leaf tube; mature larva ~22 mm long (reared to male adult), found (head downward) in Andropogon (Schizachyrium) scoparius leaf tube nest of ~6 leaves, 2 other leaf nests found within ~7 cm on this A. scoparius clump indicating that larva fed on it most of its life so egg may have been laid on A. scoparius (1 m away were ~3 empty nests on B. curtipendula, probably made by another larva); S-facing slope, Apex Gulch, Jefferson Co. Colo., Aug. 27, 1990. ~6 empty leaf tube nests found on B. curtipendula; Mt. Vernon Historic Site, Jefferson Co. Colo., Sept. 3, 1990. ~6 empty nests found on B. curtipendula; Apex Gulch, Jefferson Co. Colo., Sept. 19, 1990. Preoviposition 10:35 (hovered and landed on horizontal leaves 3X) B. curtipendula, N Pueblo, Pueblo Co. Colo. June 8, 1991. 2 empty leaf tubes found on B. curtipendula, Apex Gulch, Jefferson Co. Colo., Sept. 5, 1991. 6 eggs (distance leaf base to egg-egg to leaf tip were 9 cm-8 cm, 8-15, 12-10, 10-8, 11-5, 12-10, and 1st-stage-larva (in nest of leaf rolled under with ~6 silk ties) found on underside of level part of drooping B. curtipendula, Apex Gulch, Jefferson Co. Colo., June 8, 1992. HOSTPLANTS: Obviously Bouteloua curtipendula is the usual host, Andropogon scoparius is rarely chosen, and Andropogon gerardii is a rare host (of wandering larvae). Older larvae eat Bouteloua curtipendula well in lab, and prefer it to Bromus (Bromopsis) inermis. 1st- & 2nd-stage larvae died eating Poa pratensis. OVIPOSITION. B. curtipendula leaves are flexible and extend vertically, then laterally, then droop downward, and all the eggs were laid on the underside of the highest point of a leaf, where the leaf is horizontal and the egg is therefore most shaded (and the eggs are white so reflect the sun); most eggs were on small plants of one stalk; ovipositing females seem to look for a little nook or depression in the vegetation (usually ~40-60 cm wide), then look for B. curtipendula, then look for an overhanging leaf to place the egg under; the plants usually grow in loose patches on the upper edge of little bare areas on S-, W-, & E-facing slopes (all except north-facing slopes), but most eggs were found on S-facing slopes esp. on steep places. Mature fully-fed larvae hibernate. EGG white, slightly oval in dorsal view, hemispherical in lateral view, the micropyle a flat smooth area. 1ST-STAGE LARVA creamy-yellow, turning greenish-yellow after feeding; head & collar black. MATURE LARVA (Table 9) light-yellow-green (sometimes pale-bluish-green), heart-line slightly darker than ground color, collar narrow and black; head cream with orange-brown bands (these bands turning brownish-black on ventral 1/4 or 1/2 or rarely completely brownish-black to top, unlike other Amblyscirtes) (bands include: a wishbone-shaped mark over adfrontal sulci extends almost up to adfrontal cleavage line, a vertical band on frontoclypeus extends from anteclypeus 95% or completely up to its top, a wide band extends from fang base upward [lateral to and touching adfrontal cleavage line] and forms a broad band over coronal sulcus and narrows to neck [this band is thick at the level of bottom of coronal sulcus, so the lateral edge of this band, like A. oslari, is much less concave than in A. vialis and aenus], a wide band extends upward from eyes #3-6 and curves to join coronal sulcus band on top of head, rear rim of head orange-brown [blackish-brown ventrally, as noted above]), labrum & anteclypeus brown, fang present below adfrontal sulcus. PUPA on day of pupation pale-yellow-green on head & ventral part of wings, thorax top bluish-yellow-green, top of A1-4 pale-sky-blue, A5-7 & ventral part of A8 darker (pale-bluish-green), A8-9 pale-yellow-green, on next day head tan, bluish-yellow-green on thorax, A1-3 greenish-blue-cream esp. A2, A4-5 bluish-pale-yellow-cream, A6-9 tan-yellow-cream, wings pale-yellow-green, heart-band slightly darker on abdomen, T1 spiracle and cremaster orange-brown, proboscis chitin-brown where it extends beyond wings 4-6 mm (to near cremaster base, or usually to just beyond crochets), a supraventral low hill on A4,5,6 contains a tuft of reddish hair and large oval lenticles, proboscis extends 4-6 mm beyond wings (to near cremaster base, or usually to just beyond crochets), when about to emerge eyes turn red, then thorax becomes reddish-brown, then wings & appendages become reddish-brown, etc. Pupa lasts 15 days in lab.

Amblyscirtes phylace Edw. Oviposition 11:18 on underside of Andropogon gerardii leaf, preovipositions 10:45 on A. gerardii, Green Mtn., Jefferson Co. Colo., June 19, 1985. Preoviposition 11:15 on underside of A. gerardii leaf, Green Mtn., Jefferson Co. Colo., June 15, 1985. Larva nearly mature (parasitized) found head upward in nest of ~3 rolled Bouteloua curtipendula leaves from 2 culms (8 cm above ground), another nest of 3 leaves & 2 culms was 12 cm away in same B. curtipendula clump; nearly-mature larva found with head down in 7-cm-long tube of 3 A. gerardii leaves (20 cm above ground on plant with 40-cm-tall leaves) (A. gerardii 0-100, Agropyron [Pasconyrum] smithii 25 cm onward, Poa pratensis or Poa agassizensis 15 cm onward); SE-facing slope near gulch, Apex Gulch, Jefferson Co. Colo., Aug. 24, 1990. 5 nearly-mature/mature

larvae found in silked-leaf tubes of A. gerardii ~20 cm above ground, 1 larva was near 3 empty nests, 2 had head downward in nest (3 adult females reared)(3 larvae W-facing slope, 1 N-facing slope, 1 slightly-NW-facing ridge top); Green Mtn., Jefferson Co. Colo., Aug. 28, 1990. 2 mature larvae (yellowish-green bodies and shortened front-to-back, so in diapause) found (both with head downward) in A. gerardii silked-leaf nest tubes; E-facing valley head, Green Mtn., Jefferson Co. Colo., Sept. 1, 1990. Andropogon gerardii is obviously the favorite host, Bouteloua curtipendula a rare host; both are fairly short open-hillside grasses with wide leaves. Other hosts are surely used southward. A larva was noted to swivel its head from side to side in response to disturbance, permitting its fangs to crush an intruder to the nest. Mature fully-fed larvae hibernate. EGG cream; hemispherical, the lower edge slightly rounded (no flange). 1ST-STAGE LARVA cream, collar & head chitin-brown, head pointed dorsally. MATURE LARVA (Table 9) whitish-green (slightly yellowish at intersegmental folds), heart-band gray-green or grass-green, collar narrow, black; head cream (slightly tinged with tan on many larvae), with orange-brown (no black on lower part of face, unlike A. oslari) bands (a wishbone-shaped mark over adfrontal sulci extends almost up to adfrontal cleavage line, a vertical band on frontoclypeus extends from anteclypeus 40-90% up to its top, a wide band extends from fang base upward [lateral to and touching adfrontal cleavage line] and forms a broad band over coronal sulcus and narrows to neck [this band is thick at the level of bottom of coronal sulcus, so the lateral edge of this band, like A. oslari, is much less concave than in A. vialis and aenus], a wide band extends upward from eyes #3-6 and curves to join coronal sulcus band on top of head, rear rim of head orange-brown [blackish-brown on ventroposterior corner of postgenal]), labrum & anteclypeus brown. PUPA on first day light-green on thorax and A1, head tan-green, distal 1/2 of wings cloudy whitish-green, A2-3 greenish-cloudy-cream, on next day becoming pale-dull-yellow, abdomen mottled yellow-white (palest A2-4, less pale A5-7), rear of each A4-7 segment chitin-brown, front of head slightly tan, heart-band slightly darker esp. A5-8, a supraventral low hill on A4,5,6 contains a tuft of reddish hair and large oval lenticles, proboscis chitin-brown where it extends beyond wings 3-4.5 mm (to middle of A7, rear of A8, or cremaster base), T1 spiracle & cremaster orange-brown, when about to emerge eyes become red, then thorax & appendages become reddish-brown, etc. Pupa lasts 18 days in lab.

Table 9. Amblyscirtes larval differences.

Trait	<u>A. vialis</u>	<u>A. aenus</u>	<u>A. phylace</u>	<u>A. oslari</u>
head frosting	white frosting	none	none	none
color of head bands	dark orange-brown, rear rim often blackish	orange-brown	orange-brown	orange-brown but ventral part or all of bands blackish-brown
vertical orange-brown streak extending up from adfrontal cleavage line	present	present	absent	absent
orange-brown band beside top of frontoclypeus	narrow	narrow	broad	broad
vertical stripe on frontoclypeus	running to top, or only ventral and vague	running from bottom to top	running from bottom up to middle or to top	running from bottom to top

Atrytonopsis hianna hianna (Scud.) (=turneri F.). Oviposition 13:10 on Andropogon gerardii leaf underside 3 cm above ground, entire colony of abundant adults strictly associated with a large sward of A. gerardii; Horsetooth Res.,

Larimer Co. Colo. May 23, 1990. Adults common, associated strictly with sward of A. gerardii, Horsetooth Res., Larimer Co. Colo. May 26, 1990. The host A. gerardii was searched for larvae but none found; evidently larvae (from eggs laid in late May) grew large and crawled to the litter to hibernate mostly in Aug., prior to this date; Horsetooth Res., Larimer Co. Colo., Sept. 14-15, 1990. Adults (few) associated with Andropogon (Schizachyrium) scoparius (no Andropogon gerardii seen); S Gothenburg, Dawson Co. Neb., June 7, 1990. Older larvae must hibernate. Egg cream when laid, after 1-3 days turning frosty (whitish due to eggshell)-light-red with cream ridges; these colors are very odd for Hesperiniinae eggs; the egg resembles Pyrginae. FIRST-STAGE LARVA pale yellow, soon becoming green internally due to food, A10 has 2 long 2 short setae; head & collar black.

Pyrginae

Eparcgyreus clarus (Cram.). Oviposition 11:12 on underside of leaf of Glycyrrhiza lepidota, Marshall, Boulder Co. Colo., July 3, 1971. Oviposition 8:20 on dead leaf of Monarda fistulosa var. menthaefolia (not a larval host) several cm from many plants of G. lepidota, Chimney Gulch, Jefferson Co. Colo., July 10, 1978. Oviposition 12:15 on underside of G. lepidota leaf, Wheatridge, Jefferson Co. Colo., July 7, 1988. 5 1st-stage, 1 3rd-stage, 1 2nd-stage larvae found in nests on G. lepidota leaflets, each nest made by chewing a curved slot into the leaf to isolate a semicircular-shaped piece on leaf edge which is joined to remainder of leaf at the flap's apical (convex) end, then folded over onto top of leaf, Wheatridge, Jefferson Co. Colo., July 11, 1989. 13 mature larvae found on top of G. lepidota plants, each in nests of ~8-10 leaves silked together, larvae bite if disturbed, most pupated by Sept. 15 in lab, Wheatridge, Jefferson Co. Colo., Sept. 7, 1989. 3 full-grown larvae found in leaf nests on tops of G. lepidota plants, no pupae found so larvae must crawl somewhere else (probably into litter) to pupate in nature, Wheatridge, Jefferson Co. Colo., Sept. 18, 1989. Oviposition 12:48 on G. lepidota leaflet underside; Wheatridge, Jefferson Co. Colo., July 7, 1990. 12-mm-long larva (~3rd stage) found in nest of 2 G. lepidota leaves; Falcon County Park, Jefferson Co. Colo., July 10, 1990. Egg found on G. lepidota leaf top; Wheatridge, Jefferson Co. Colo., July 26, 1990. 4 larvae nearly to fully mature found in G. lepidota leaf nests, consisting of several leaves on top of plants (1.5-2 m above ground); Wheatridge, Jefferson Co. Colo., Aug. 4, 1990. 10 mature larvae found in G. lepidota leaf nests ~1.5 m above ground; Wheatridge, Jefferson Co. Colo., Sept. 4, 1990. 1 mature larva found in G. lepidota leaf nest, ~8 empty nests seen; Wheatridge, Jefferson Co. Colo., Sept. 26, 1990. ~15 1st-3rd-stage larvae found under cut flaps of G. lepidota leaves, Wheatridge, Jefferson Co. Colo., July 20, 1991. 2 mature larvae found in G. lepidota nests, Wheatridge, Jefferson Co. Colo., Aug. 22, 1991. ~10 4th-5th-stage larvae found in G. lepidota nests, Wheatridge, Jefferson Co. Colo., Aug. 26, 1991. ~12 mature larvae found in G. lepidota nests, Wheatridge, Jefferson Co. Colo., Aug. 27, 1991. Mature larva found in leaf nest on top of G. lepidota, Marshall, Boulder Co. Colo., Aug. 29, 1991. ~15 larvae (most mature) found on top of G. lepidota plants 30-40 cm tall, Wheatridge, Jefferson Co. Colo., Sept. 2, 1991. ~15 larvae & nests found on G. lepidota, Wheatridge, Jefferson Co. Colo., Sept. 3, 1991. Mature larva found G. lepidota (most larval nests empty now, indicating larvae pupate in litter); 3 empty larval nests found on Robinia sp. probably pseudoacacia; Wheatridge, Jefferson Co. Colo., Oct. 1, 1991. Two eggs found on underside of leaves of Robinia pseudoacacia (previously misidentified as Robinia neomexicana), Lakewood, Jefferson Co. Colo., July 9, 1977. 4 larvae on R. pseudoacacia (previously misident. as R. neomexicana), Lakewood, Jefferson Co. Colo., Aug. 4, 1978. Mature larva in silk nest of 2 leaves silked together on R. pseudoacacia, Lakewood, Jefferson Co. Colo., July 20, 1988. 1 mature larva & 2 empty nests found on R. pseudoacacia; W Idledale, Jefferson Co. Colo., Oct. 1, 1990. 1st-stage larva found in flap nest on top of Robinia neomexicana leaf, Lakewood, Jefferson Co. Colo., June 26, 1992. Adults associated with Lotus crassifolius (M), 5 mi. SE Goat Mtn., Colusa Co. Calif., June 8, 1974. G. lepidota (up to 1.5 m tall) and Robinia (up to ~8 m tall) are the largest legumes in Colo., so E. clarus evidently demands large legumes, and mature larvae make nests at the top of G. lepidota plants. 1st-3rd stage larvae make a nest by folding over a flap of leaf edge on top of one leaf, whereas mature larvae silk several leaves into a nest, typically on top (1-2 m) of herbs or even higher on trees. Pupae hibernate, evidently in loosely-silked litter, because mature larvae disappear from the larval nests to pupate. Early stages from Colo.: Egg pale greenish-cream, a day later becoming cream with a lateral red ring and a red point on top. 1ST-STAGE LARVA bright yellow including legs and prolegs, but dorsal part of body from A6 forward gradually becomes greener

due to food so that 12-3 are light green dorsally, T1 red-brown; head & collar black. 2ND-3RD-STAGE LARVA light yellow including legs and prolegs, T1 red-brown (T1 redder than 1st-stage); head & collar black. MATURE LARVA light-(very slightly greenish)-yellow, with many interrupted (dashed) gray transverse lines interspersed with narrow black transverse lines (these black lines limited to top half of body, and one black line on front of each segment is widened subdorsally, above each spiracle is 1 or 2 black transverse dashes; the black lines vary, a larva on R. pseudoacacia July 20, 1988, had black lines nearly absent, whereas larvae on G. lepidota Sept. 7, 1989, all had strong black lines), collar red-brown, prothorax reddish beneath, true legs reddish, anterior eight prolegs orangish-yellow, a small black suranal plate on front of A10, spiracles black; head red-brown, with a large orange spot medial to the white eyes. PUPA reddish-brown (orange-brown on abdomen, light orange-brown between segments A4-5, 5-6, 6-7), mottled with fine tiny sinuous black and pale lines, mostly covered with a bluish-white bloom, a weak brown subspiracular band on abdomen, T1 spiracle black, lateral base of cremaster black.

Zestusa dorus (Edw.). Adults associated with Quercus gambelii in N New Mex. and SW Colo.

Thorybes pylades pylades (Scud.). Oviposition 14:00 on underside of leaf of Lathyrus leucanthus, Red Rocks, Jefferson Co. Colo., May 23, 1977. Adults associated with L. leucanthus, Jarre Can., Douglas Co. Colo., May 27, 1988. Oviposition 14:44 on leaf underside of L. leucanthus 8-cm-tall seedling, she landed on ~15 larger plants before ovipositing, so females must prefer seedlings; Apex Gulch, Jefferson Co. Colo., May 31, 1990. L. leucanthus may be the favorite Colo. host; it has long dried up by Sept., so larvae must mature in July or E Aug., and spend a long time in diapause. Adults associated with Lotus crassifolius (M), 5 mi. NE Goat Mtn., Colusa Co. Calif., June 8, 1974. EGG milky-white; no color change even in 4 days.

Thorybes mexicana mexicana (H.-S.). Oviposition 13:12 Trifolium rusbyi (=longipes, the name given in Scott 1986a), Hopewell Lake Cgd., Rio Arriba Co. New Mex., June 21, 1978. Oviposition 9:49 on T. rusbyi (W), 1 mi. E Hopewell Lake Cgd., Rio Arriba Co. New Mex., June 21, 1978. Ovipositions 12:25 & 12:30 on underside of leaves of Vicia americana (W), Hopewell Lake, Rio Arriba Co. New Mex., June 21, 1978.

Thorybes diversus Bell. Adults common associated with Vicia americana, tiny coniferous forest clearings S of Mather, Tuolumne Co., Calif., June 11, 1972.

Erynnis icelus (Scud. & Burg.). Oviposition 12:43 on leaf of 10 cm Populus tremula tremuloides seedling, Hopewell Lake Cgd., Rio Arriba Co. New Mex., June 21, 1978. Oviposition, she fluttered 13:00-13:13 about P. t. tremuloides plants 10-30 cm tall, then found a P. t. tremuloides seedling 10-cm tall with just-emerged leaves (terminal leaves tiny), hovered over it twice and landed twice, laid egg 13:14 on stem 3 cm from seedling tip; Tinytown, Jefferson Co. Colo., June 21, 1990. Females evidently oviposit only on seedlings. EGG cream with scattered tiny yellow spots when laid, when 1 day old turning bright-orange, then red (dark red by 3 days), with ~13 vertical ribs.

Erynnis brizo brizo (Bdv. & Lec.). Oviposition 10:17 on 1.5-mm wide twig underside 5 mm from tip which had a 3-mm reddish-brown tiny unfolded leaf, on the tip of a 10-cm long young sprout on ground beneath a 2 m high bush, all of Quercus gambelii; Tinytown, Jefferson Co. Colo., May 30, 1990. Preoviposition 10-20 cm tall Q. gambelii seedlings, Tinytown, Jefferson Co. Colo., June 2, 1988. Preoviposition 11:30-11:45, she landed on tops of terminal buds of young Q. gambelii seedlings, Tinytown, Jefferson Co. Colo., May 18, 1989. Preoviposition on probably Q. gambelii undulata (which is actually a hybrid taxon introgressed to other oaks, mostly introgressed to Quercus havardii in this area, so there is not much difference between havardii and undulata; this record was reported as Q. havardii by Scott 1986a)(1 m shrubs in thickets with 3-cm-long live-oak-type leaves), 8 mi. W. Roy, Harding Co. New Mex., May 12, 1985. E. brizo, like its close relative E. icelus, evidently oviposits only on seedling plants, while E. telemachus oviposits on young leaves of mature plants. EGG slightly-greenish cream when laid, light-orange (slightly lighter than E. icelus) when 1 day old, orangish-red in 2 days, red a day or so later, with ~18 vertical ribs (many more than icelus).

Erynnis martialis (Scud.). Oviposition 9:20 on leaf below flower buds of Ceanothus fendleri, Ralston Butte, Jefferson Co. Colo., June 20, 1980. Oviposition 15:11 on underside of young new C. fendleri leaf at plant base, Tinytown, Jefferson Co. Colo., May 16, 1988. Preoviposition 13:08, bent abdomen to C. fendleri flower buds; Red Rocks, Jefferson Co. Colo., June 18, 1990. Female bent abdomen twice to C. fendleri flowers, Tinytown, Jefferson Co. Colo., July 3, 1991. Oviposition 13:15 young leaf base of new-growth C. fendleri branch at clump base, Tinytown, Jefferson Co. Colo., June 13, 1992. Oviposition

12:01 Base of young C. fendleri leaf, Tinytown, Jefferson Co. Colo., June 16, 1992. Females oviposit on mature plants, but on new growth. Egg cream, orangish-yellow after 1 day, light-orange after several days, then pale yellow

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as larva develops inside, 2 eggs had 15 and 17 vertical ribs. 1ST-STAGE LARVA ochre; head slightly-orangish ochre.

Erynnis pacuvius pacuvius (Lint.). Oviposition 10:00 on base of young leaf 3 cm from end of Ceanothus fendleri branch, Ralston Buttes, Jefferson Co. Colo., May 29, 1988. Oviposition 14:41 on side of tiny leaf petiole beside C. fendleri terminal flower bud cluster, Tinytown, Jefferson Co. Colo., June 1, 1988. Preoviposition 14:08 C. fendleri, Tinytown, Jefferson Co. Colo., May 18, 1989. Preoviposition 10:10; Tinytown, Jefferson Co. Colo., May 30, 1990. 1 eggshell with 15 ribs (possibly of E. martialis) found on C. fendleri, preoviposition 15:00 C. fendleri; NE Crawford Gulch, Jefferson Co. Colo., June 20, 1990. Preoviposition 12:25 on Arctostaphylos uva-ursi adenotricha (the female perhaps fooled by the prostrate bush and small leaves like the host), Coal Creek, Jefferson Co. Colo., July 17, 1991. Females oviposit on mature plants, near new growth. Egg greenish-cream, either not changing color or the eggs were sterile.

Erynnis telemachus. Preoviposition 10:00 Quercus gambelii, Jarre Can., Douglas Co. Colo., May 11, 1988. Preoviposition 11:55 Q. gambelii leaf buds, Jarre Can., Douglas Co. Colo., May 13, 1988. Oviposition 12:41 on underside of Q. gambelii twig with tiny 6-10 mm leaves 1.5 cm from tip of twig, Tinytown, Jefferson Co. Colo., June 1, 1988. Oviposition 11:51 petiole of 10 mm young leaf at end of Q. gambelii twig that had 4 male catkins, Tinytown, Jefferson Co. Colo., June 2, 1988. Oviposition 12:49 on top of tip of nearly-dried 5 cm long Q. gambelii leaf, Tinytown, Jefferson Co. Colo., June 3, 1988. 4 eggs found on Q. gambelii twig tips at the base of 2 cm long young leaves, all ~1.5 m above ground (not on seedlings), Phillipsburg, Jefferson Co. Colo., June 17, 1989. Female preoviposited 10:30-10:50 only on ~5 seedlings, oviposition 10:51 on stem among very young 15-17-mm leaves on tip of 10-cm-tall seedling Q. gambelii, Tinytown, Jefferson Co. Colo., May 21, 1992. Females evidently prefer to lay eggs on twigs, petioles, and dried leaf tips rather than on green leaves, and oviposit both on tall plants and on seedlings. Egg cream or yellowish-cream when laid, after 1 day turning bright red, with 15-16 vertical ribs. FIRST-STAGE LARVA ochre-tan (cream on rear and neck) or light-brown, appearing brownish internally (due to food?), collar narrow, black; head black with cream setae.

Erynnis persius (Scud.). Oviposition on leaf of Astragalus sp. (probably bisulcatus but no pods present) (G, W), Rosita, Custer Co. Colo., June 27, 1989. Oviposition 10:02 leaflet of Astragalus flexuosus, grassland S of Idledale 7500', Jefferson Co. Colo., June 10, 1980. Oviposition 11:19 on underside of A. flexuosus young leaflet, before laying she ignored Astragalus adsurgens var. robustior 10 times, ignored A. flexuosus 5 times, ignored Lupinus argenteus 5 times, rested on Astragalus agrestis 4 times but did not lay, Guy Hill, Jefferson Co. Colo., June 14, 1988. Oviposition 8:44 on underside of A. flexuosus leaflet base, Guy Hill, Jefferson Co. Colo., June 16, 1988. Oviposition 15:12 A. flexuosus on base of flower peduncle 2 cm from flower buds, Guy Hill, Jefferson Co. Colo., June 24, 1988. Oviposition 11:05, 11:07 under A. flexuosus stems not near buds, oviposition 11:28 under A. flexuosus stem 1 cm below flower buds, Tinytown, Jefferson Co. Colo., June 5, 1991. Oviposition 10:33 stem just below new leaf, oviposition 10:20 rachis of 1/3-eaten leaf, both on A. flexuosus, Tinytown, Jefferson Co. Colo., June 11, 1992. Oviposition 13:51 rachis within A. flexuosus leaf, Tinytown, Jefferson Co. Colo., June 16, 1992. Oviposition 11:37 A. flexuosus leaflet underside, Guy Hill, Jefferson Co. Colo., June 22, 1992. Oviposition 8:41 on underside of A. flexuosus leaf beside flower buds, ovip. 10:01 on underside of A. flexuosus stem 1 mm from flower buds, ovip. 10:10 on underside of A. flexuosus leaf 2 mm from flower buds, ovip. 14:01 on underside of Lupinus argenteus leaf base, Guy Hill, Jefferson Co. Colo., June 17, 1988. Oviposition 11:28 on leaflet of L. argenteus, North Table Mtn., Jefferson Co. Colo., June 4, 1980. Oviposition 12:05 on side of L. argenteus stem, Guy Hill, Jefferson Co. Colo., June 27, 1986. Oviposition 10:14 on underside of L. argenteus leaf base, Guy Hill, Jefferson Co. Colo., June 10, 1988. Oviposition 11:40 L. argenteus leaf petiole base, preoviposition 12:00 Astragalus flexuosus; Lookout Mtn., Jefferson Co. Colo., June 6, 1991. Oviposition 13:03 L. argenteus (white-flowered var.) stem 2 cm below flower buds, Tinytown, Jefferson Co. Colo., July 1, 1991. Oviposition young plant of Thermopsis sp. (W), Hopewell Lake 9800', Rio Arriba Co. New Mex., June 21, 1978. Preoviposition 12:54 Thermopsis divaricarpa, Mt. Falcon, Jefferson Co. Colo., May 30, 1980. Oviposition 12:28 on underside of young leaf of T. divaricarpa, SE Golden Gate Can. State Park, Gilpin Co. Colo., June 17, 1984. Oviposition

12:20 on stem just above leaf junction of T. divaricarpa, Green Mtn., Jefferson Co. Colo., June 9, 1986. Oviposition 11:30 on underside of petiole at base of leaflet of T. divaricarpa, Corwina Park, Jefferson Co. Colo., July 4, 1986. Preoviposition T. divaricarpa (bent abdomen 2 sec), Tinytown, Jefferson Co. Colo., May 17, 1988. Oviposition 10:45 stem of small T. divaricarpa, Tinytown, Jefferson Co. Colo., June 2, 1992. Oviposition 9:21 on underside of young 1-cm-long leaflet of T. divaricarpa after ignoring older plants of A. flexuosus, Trifolium pratense, Melilotus officinalis; oviposition 9:36 on base of leaflet of 2/3-grown 2-cm-long leaflet of T. divaricarpa; oviposition 10:23 base of very young 6-mm-long leaflets of L. argenteus var. (white flowers no banner spot, glabrous plane leaves; it is not ingratus which has white flowers but has a banner spot and glabrous folded leaves); Tinytown, Jefferson Co. Colo., June 25, 1990. Oviposition 12:18 on end of petiole just below L. argenteus var. (white flowers no banner spot, glabrous plane leaves) leaflets (the plant was 8 cm tall with only 4 leaves), she ignored A. flexuosus and Trifolium repens for 20 min. before laying; Tinytown, Jefferson Co. Colo., June 21, 1990. Oviposition 13:05 on base of new 6-mm-long leaflets 2 cm from end of young branch of L. argenteus var. (white flowers no banner spot, glabrous plane leaves), 2 preovipositions on white var.; Tinytown, Jefferson Co. Colo., June 24, 1990. Orange egg and empty eggshell found on leaflet base (side) of L. argenteus var. (white flowers no banner spot, glabrous plane leaves); Tinytown, Jefferson Co. Colo., June 28, 1990. Half-grown larva found in nest of ~5 silked-together flowers of L. argenteus var. (white flowers no banner spot, glabrous plane leaves); Tinytown, Jefferson Co. Colo., July 15, 1990. Females may prefer Astragalus (esp. flexuosus), Lupinus argenteus, and Thermopsis divaricarpa in the Colo. Front Range foothills, but these are the most common hillside legumes, so other legumes may be chosen too when available. E. afranius is known to eat the last two plants so may have very similar hostplant preference. Females oviposit on leaflets most often, sometimes on stems, often near new growth or flower buds. Mature larvae hibernate. Egg cream, turning light orange in 1 day, orange 3-4 days later, with ~15 vertical ribs. 1ST-STAGE LARVA pale ochre with cream setae, collar brown; head brownish-black. MATURE LARVA light-creamy-green, slightly pinkish in intersegmental areas, heart-band darker green, a narrow cream subdorsal line, a very faint slightly paler spiracular band; head black with ochre-cream areas (one tiny dark-ochre spot on lower corner of frontoclypeus, a rectangle on forehead [lateral to coronal sulcus] extends upward and then turns laterally and narrows and runs a short distance to side of head, just above [and broadly-connected to] an oval on side of face, which is narrowly-connected to an oval on front of gena [which lies mostly below rectangle], a pale comma behind eyes); head is blacker with much smaller and paler spots than E. afranius, the pale color limited to discrete spots and not diffused over head as in afranius.

Erynnis afranius (Linn.). Oviposition Lupinus argenteus, Gregory Can., Boulder Co. Colo., May 1966. Oviposition on leaf of Lupinus caudatus seedling (seedlings cannot be identified, but a pressed flowering plant is caudatus), Box Elder Creek, Arapahoe Co. Colo., Aug. 8, 1973. Oviposition 10:14 on underside of immature leaf petiole, oviposition 10:18 on underside of old shriveled leaflet base, oviposition 13:35 on upperside of upside-down young leaflet and an egg found on petiole of this leaf, egg found on underside of young leaf, eggshell found on leaflet petiole and a 1st stage larva found between 2 of 3 unopened leaflets of same leaf, all on Thermopsis divaricarpa, Wheatridge, Jefferson Co. Colo., July 13, 1988. Preoviposition 9:16 T. divaricarpa, Wheatridge, Jefferson Co. Colo., July 15, 1988. 4 larvae 10-15 mm long in leaf nests (1 largest larva between two leaves silked together, 3 smaller larvae in nest of leaf folded upward), all on T. divaricarpa, Wheatridge, Jefferson Co. Colo., Aug. 12, 1988. 3 larvae found, all in silk leaf nests of several T. divaricarpa leaves silked together, all mature larvae rest in a J-shape in the nest (the head and prothorax bent laterally toward the rear), Wheatridge, Jefferson Co. Colo., Aug. 22, 1988. ~50 eggs, 6 sucked-dry eggs, & many eggshells & 1st- & 2nd-stage larvae found on upper part of T. divaricarpa plants on the outer periphery of a stand, most eggs were found on leaf underside esp. toward leaf base, ~6 seen on stem, 2 on leaf upperside; Wheatridge, Jefferson Co. Colo., Aug. 11, 1990. 4 older larvae found in T. divaricarpa leaf nests; Wheatridge, Jefferson Co. Colo., Sept. 4, 1990. 1 mature larva in nest of several leaves, 1 empty nest, both on T. divaricarpa; Wheatridge, Jefferson Co. Colo., Sept. 26, 1990. 2 eggs and 2 eggshells found under leaves, 1 eggshell found on small stem, 1 first-stage larva among young leaves, all on T. divaricarpa; no eggs found on Lupinus argenteus, Astragalus drummondii, Astragalus bisulcatus; Box Elder Creek, Elbert Co. Colo., May 26, 1991. A 4th-stage larva found in T. divaricarpa leaf nest, Wheatridge, Jefferson Co. Colo.,

Aug. 22, 1991. Larvae (2 2nd-stage, 4 1st-20-mm-long) found in T. divaricarpa leaf nests, Wheatridge, Jefferson Co. Colo., Aug. 26, 1991. Mature larva found in T. divaricarpa leaf nest, Wheatridge, Jefferson Co. Colo., Sept. 2, 1991. 2 empty larval nests found on T. divaricarpa, Green Mtn., Jefferson Co. Colo., Sept. 17, 1991. The hostplant specificity seems identical or similar to that of E. persius, based on the few records. E. afranius is usually uncommon or rare on the E slope of Colo., which has retarded the discovery of hostplants, but it was common at Wheatridge in 1988 and slightly less common there in 1990 and 1991. Females oviposit near the top of mature plants, often near new growth. The hatching larva generally makes a nest in a tiny young expanding topmost leaf which is already folded (not yet spread), obviously to save time and energy that would be required to fold an expanded leaf. Mature larvae hibernate, in the larval leaf nest. Early stages from Wheatridge: EGG cream, later turning yellowish then reddish-orange. 1ST-STAGE LARVA pale yellow with cream setae, collar brown; head brownish-orange with cream setae. 2ND-STAGE LARVA pale-yellow (greenish in middle of body), heart-line slightly darker; head black. MATURE (4TH-5TH-STAGE) LARVA light green (sometimes light-yellowish-green such that when the larva turns the bunched-up exoskeleton takes on a tan tint, one larva more grass-green), with many tiny white seta bases, with a dorsolateral cream line, a middorsal dark-green line; no black collar; head blackish-brown on rim and rear, the front ochre-brown, a blackish-brown horizontal bar filling upper half of frontoclypeus extends laterally to middle of gena and a dark-brown streak angles up from it to temple, an ochre spot in front of eyes, a larger ochre spot above that spot on side of head (just below the previous dark-brown streak), an ochre subdorsal band terminated anteriorly by an ochre spot, the notch along coronal sulcus edged by blackish-brown with a tiny blackish-brown dot near frontoclypeus. When diapausing, top of body develops an orange-brown tint esp. in intersegmental areas, and the pale areas on head become brown. PUPA light-green, abdomen light-yellow-green, (the head and middle of wings are slightly tan on several pupae), T1 spiracle a black protruding rounded cone, cremaster pinkish-cream with orangish hooks, very tip of proboscis orangish-brown; pupa develops a smoky suffusion on head (except eyes), thorax, appendages, and middle of wings. Pupa rests in nest of 2 leaves silked together, held in place by silk girdle and cremaster.

Pyrrhus centaureae loki Evans. Oviposition 12:15 on Vaccinium cespitosum (not a hostplant) next to Potentilla diversifolia (W), and preoviposition on another P. diversifolia plant, Loveland Pass, Summit Co. Colo., July 17, 1977. Preoviposition 10:53, she landed on Dryas octopetala hookeriana and landed next to P. diversifolia, Loveland Pass, Clear Creek Co., Colo., July 19, 1989.

Pyrrhus xanthus Edw. Ovipositions 13:17 & 13:20 at base of leaf of small plants of Potentilla pulcherrima (W), W Hopewell Lake Cgd., Rio Arriba Co. New Mex., June 20, 1978. Adults associated with blooming P. pulcherrima, and with Potentilla hippiana (which blooms here in July) and P. hippiana X pulcherrima (which blooms here in July); SW Como, Park Co. Colo., June 2, 1990. 2 half-grown larvae found on P. pulcherrima (1 larva on a tiny 3-leaf plant, the nest on 1 leaflet, the edges folded up and together; 1 larva on a tiny 4-leaf plant, the nest formed of the 2 basal leaflets [of 5 on the leaf] closed up above the petiole and silked together), reared to pupae; SW Como, Park Co. Colo., July 17, 1990. A 1-cm-long larva (~3rd or 4th stage) found on leaflet 2 cm wide of Potentilla pulcherrima plant with ~5 leaves & 2 empty nests (all nests were leaflets folded upward and laterally); no larvae found on common Potentilla hippiana or the 2-3 Potentilla pensylvanica plants, SW Como, Park Co. Colo., Aug. 20, 1991. Oviposition 11:00 on stalk of stamen of flower of Potentilla subviscosa (W) after 5 preovipositions among flowers of this species (adults very often fed on P. subviscosa nectar also), Ledoux, Mora Co. New Mex., May 15, 1985; the abundant males patrolled about P. subviscosa to seek females here, and perched among them about 50% of the time to await females; a few males perched in an adjacent gulch bottom (the preferred mate-location site at low density). Adults associated with and preovip. on non-flowering Potentilla ambigua (W) (surely the hostplant here), Cloudcroft, Otero Co. New Mex., April 21, 1972, where high-density males patrolled about this plant. Adults associated with both P. pulcherrima and P. hippiana (W) at 4 sites: at Rosita, Custer Co. Colo., May 1972, Luders Creek Cgd., Saguache Co. Colo., May 28, 1972, Poncha Pass, Saguache Co. Colo., May 27, 1972, and Trout Creek Pass, Chaffee Co. Colo. Adults associated with P. hippiana (W) and perhaps others at Devil's Hole, Huerfano Co. Colo. (Note: the P. hippiana plants from the last 5 sites were previously misidentified as Potentilla [Argentina] anserina [see Scott 1975b and Scott & Scott 1980] but have been reidentified as P. hippiana [all W and myself]; P. anserina is an erroneous host record.) Adults associated with P. hippiana (W) and Potentilla pensylvanica, Bartlett Mesa N of Raton, Colfax Co.

New Mex., May 3, 1972. Females apparently prefer to lay eggs inside host flowers if present, but lay on young leaves if flowers are not common. P. pulcherrima seems to be the most common Colo. hostplant, because the larvae were found on it, it blooms when the adults fly, eggs evidently are preferably laid on flowers or new growth, and ovipositions have been seen on it. P. hippiana could be a host also, because it is common wherever P. xanthus occurs, usually the commonest Potentilla; but there are no records yet, and it blooms in July so females could not lay in its flowers. Larvae ate P. pulcherrima and P. hippiana well in lab. Potentilla pensylvanica and P. anserina are much less common, and both bloom in July, as does many P. hippiana X P. pulcherrima; P. anserina is less likely to be a host because it is in a separate subgenus. Adults fly only 2-5 cm above ground. No diapause in lab (but pupae could hibernate because they were pickled). EGG pale-green. HALF-GROWN LARVA dull pale creamy-bluish-green with many cream dots (each bearing a seta), heart-line darker bluish-green, T1 gray-black, legs & collar black; head black; larva rests in a silk nest on top of a leaf, the head & thorax curved so that head faces toward rear. HALF-GROWN LARVA cream-tan with slight blue-green tinge in middle of body (the blue-green becoming more widespread by 4th-stage, heart-line green, 2 lateral rows of faint tan lines; collar and head black. MATURE LARVA green, the dorsal half of body slightly-reddish-yellow (reddish-yellow on intersegmental areas), a darker gray-green heart-band, a pale dot at base of each whitish hair, T1 black, legs & collar black; head black. PUPA less than 1 day old head & top of thorax greenish-black, appendages & wing bases dark green, wing tips olive green, abdomen dark-orangish-brown with many black spots (including black patches near heart-line, subdorsal and supraventral black spots, the front half of A5, A6, & A7 brownish-black), cremaster blackish-brown, long (~0.5 mm) tan hairs common all over body except absent on wings & appendages. Pupa after about a day bluish-gray (glaucous, because the greenish head, thorax, & wings have become mostly glaucous) with black pattern, head glaucous but front of head and orbit blackish, blackish lines edge the appendages, wing veins pale glaucous, wing cells slightly darker glaucous-tan, abdomen dark-orangish-brown (including intersegmental areas), a middorsal blackish band on thorax, a row of black abdomen spots just beside middorsal area, a subdorsal black band on thorax and a subdorsal row of black spots on abdomen, front half of each abdomen segment black (the black rim widest anteriorly). Pupa attached by cremaster (no silk girdle), in nest made by silking a web over host leaf.

Pyrus scriptura (Bdv.). Oviposition Sphaeralcea coccinea, Green Mtn., Jefferson Co. Colo., July 17, 1973. Adults associated with S. coccinea; Horsetooth Res., Larimer Co. Colo. May 23, 1990. Adults also fly near ground. EGG cream.

Pyrus communis communis (Grote). Larva raised from Malva neglecta, Coaldale, Fremont Co. Colo., Sept. 10, 1971. Oviposition 12:00 M. neglecta, Lockeford, San Joaquin Co. Calif., Sept. 15, 1973. Oviposition 10:34 on underside of 3 mm leaf of 15 mm seedling of M. neglecta, Cherry Creek Reservoir, Arapahoe Co. Colo., Sept. 3, 1987. Oviposition 15:49 on underside of leaf, oviposition 15:49 on underside of sepals of 8 mm-wide fruit, both on M. neglecta, Golden, Jefferson Co. Colo., Aug. 13, 1988. Oviposition 12:55 Sphaeralcea coccinea (6), Bull Domingo Hills, Custer Co. Colo., July 8, 1969. Oviposition S. coccinea, Green Mtn., Jefferson Co. Colo., July 23, 1973. Oviposition S. coccinea, 1 mi. S Silver Cliffe, Custer Co. Colo., Aug. 7, 1965. Oviposition 11:55 on leaf of S. coccinea, Lowry Bombing Range, Arapahoe Co. Colo., Aug. 11, 1978. Oviposition 10:24 on top of leaf of S. coccinea, Green Mtn., Jefferson Co. Colo., June 7, 1985. Ovipositions 13:10, 13:14, and another egg found, all on S. coccinea (Pursh) Rydb. seedlings 1-2 cm tall (2 eggs on top of leaf, one egg on grass 2.5 cm from seedling S. coccinea), when ovipositing she bends one antenna slowly down to near plant, Green Mtn., Jefferson Co. Colo., Sept. 21, 1987. Oviposition 12:10 on top of junction at leaf base of S. coccinea, Red Rocks, Jefferson Co. Colo., Sept. 22, 1987. Oviposition 11:35 on S. coccinea; Horsetooth Res., Larimer Co. Colo. May 23, 1990. Oviposition 11:30 Sphaeralcea parvifolia (W), 2 mi. N Mesa Co. line S of Gateway, Mesa Co. Colo., May 1, 1978. 3rd stage larva found in silked leaf nest (the leaf folded over with the larva inside) on Sidalcea neomexicana, Bijou Creek, Elbert Co. Colo., Aug. 22, 1984. Adults associated with S. neomexicana (W) at Questa, Taos Co. New Mex., Sept. 10, 1977, and at La Madera, Rio Arriba Co. New Mex., Sept. 10, 1977, and at Peter's Spring, 5 mi. N Monticello, San Juan Co. Utah, Aug. 24, 1977, and at NE Lochiel, Santa Cruz Co. Ariz., Aug. 7, 1986. In central Colo., larvae eat Malva in towns, Sidalcea in moist meadows, Sphaeralcea on grassland.

Pholisora catullus (Fabr.). Larva raised from Amaranthus retroflexus, Woodmen Valley, El Paso Co. Colo., Aug. 26, 1973. Larva found on A. retroflexus, Woodmen Valley, El Paso Co. Colo., July 10, 1977. 5 larvae on A. retroflexus,

Green Mtn., Jefferson Co. Colo., Aug. 12 & 18, 1977. Larva on A. retroflexus, N of Idledale, Jefferson Co. Colo., Aug. 21, 1977. 1 egg on A. retroflexus, 10 mi. SW Elbert, El Paso Co. Colo., July 3, 1978. Oviposition 10:00 on upperside of leaf of A. retroflexus, Lowry Bombing Range, Arapahoe Co. Colo., Aug. 11, 1978. Many eggs and larvae on A. retroflexus, Green Mtn., Jefferson Co. Colo., Aug. 14, 1978. Larvae on A. retroflexus raised to adults, Kansas City Airport, Missouri, July 14, 1977. 30 eggs and 8 larvae on Amaranthus blitoides (= gracizans), N of Boulder, Boulder Co. Colo., Aug. 24, 1973. 6 larvae on A. retroflexus, 3 larvae on Chenopodium album, both Timnath, Larimer Co. Colo., Aug. 28, 1973. 1 egg and 1 large larva on Amaranthus albus, 30 eggs and 23 larvae on A. retroflexus, 5 eggs and 10 larvae on A. blitoides, 1 egg on C. album, all Green Mtn., Jefferson Co. Colo., Aug. 30, 1973. Eggs are laid singly on top of leaves. Young larvae roll the edge of a leaf and feed on the epidermis; older larvae live in a rolled leaf or tie small leaves together into a nest. Most of these hosts are weeds (A. retroflexus is the commonest weed in agricultural fields in Colo., A. blitoides is common on sidewalks and roadsides). The butterflies fly along gulch bottoms, roadsides, and the edges of fields where these weeds occur. Three host genera reported in the literature (Ambrosia trifida, Monarda fistulosa var. menthaefolia, and Marrubium vulgare) are all errors, because 30 larvae put in a container with only these three plants ate NONE of them. No diapause in lab. Early stages from Colo.: EGG reddish-tan, which about 9 bumps around the top. MATURE LARVA green, with ochre-yellow areas, a middorsal dark-green band, a weak supraspiracular ochre-yellow band, a tiny pale dot beneath each short knobbed tan hair, a black collar divided middorsally; head black with short tan hairs. PUPA chitin-brown, but covered with a bluish-white bloom, T1 spiracle red-brown with black center and protruding, numerous hairs on head, top of thorax, and abdomen (the hairs shorter [$\sim 1/3$ mm] than those of P. mexicanus).

Pholisora mexicanus (Reak.). Many larvae found on Amaranthus retroflexus reared to adults, Woodmen Valley, El Paso Co. Colo., Aug. 26, 1973. Several larvae from A. retroflexus raised to adults, Woodmen Valley, El Paso Co. Colo., July 10, 1977. Oviposition on top of leaf of Amaranthus blitoides (= gracizans), Kerr Gulch, Fremont Co. Colo., Aug. 15, 1973. A young larva ate Chenopodium sp. in the lab. Larvae roll leaves and have the same habits as catullus; adults fly along gulch bottoms, railroad tracks, and roadsides. No diapause in lab. Early stages from Woodmen Valley: EGG reddish-tan, with about 9 bumps around the top. MATURE LARVA green, with ochre-yellow areas, a middorsal dark-green band, probably a weak supraspiracular ochre-yellow band, a tiny pale dot beneath each long unknobbed tan hair, a black collar divided middorsally; head black with long tan hairs; body and head hairs about twice as long as those of P. catullus, without knobs. PUPA chitin-brown, but covered with a bluish-white bloom, T1 spiracle red-brown with black center and protruding, numerous hairs on head, top of thorax, and abdomen (the hairs longer than those of P. catullus [~ 0.5 mm], but about the same in number).

Hesperopsis libya confertiblanca J. Scott, NEW SUBSPECIES. (Note: the ending -a in this and my previous published names does not constitute a gender but is used merely for better pronunciation [the name confertiblanca has no gonads or hormones or sex whatsoever], so ICZN-pedants should not change the ending to -us in their ludicrous perverted lust to match the sex of species and subspecies names with the sex of genus names.) All adults have the unh TOTALLY cream (the only mark being a slightly-whiter central spot), the upf with a distinct median white band, distinguishing them from other ssp. (which have the unh mostly black). Types: all from type locality N Montrose, Montrose Co. Colo., July 19, 1988: holotype male and allotype female to Nat. Hist. Mus. Los Angeles County, 16 male 9 female paratypes in my coll. Occurs on hot lowland desert scrub hills at least in Montrose and Delta Cos., Colo.; probably Garfield Co., Colo. Oviposition 9:17 on top of leaf (the female upside down while ovipositing) of Atriplex confertifolia, ~26 eggs and 3 1st-stage larvae found on A. confertifolia (all eggs on top of leaves), mostly near ends of branches that stick up on side or top of plant but some low down on side of bush, all on the more succulent bushes, the 1st stage larvae crawl to where 2 leaves are just ~1 mm apart and silk them together for a nest; N Montrose, Montrose Co. Colo., July 19, 1988. The hostplant is unique, because other P. libya ssp. eat Atriplex canescens. A. canescens occurred low on a W-facing slope at this site, but adults ignored it (they often landed on A. confertifolia), and larvae refused to eat it in lab (they ate A. confertifolia in lab). EGG tan on top, whitish-tan on sides. FIRST-STAGE LARVA light-ochre; head black.

Hesperopsis alpheus alpheus. Adults associated with Atriplex canescens in Pueblo and Fremont Cos., Colo.

Oviposition Time. 1509 total ovipositions were observed, including 1402 ovipositions with time recorded, and 107 ovipositions without time recorded (Table 10). 10:00 to 12:30 is the most common time. There is not much difference between taxa in times of observed oviposition, although Lycaenidae seem to have a wider spread of oviposition times (frequent from 9:00-14:30), and Pyrginae may have a slightly-wider-than-usual spread of oviposition times (but with comparatively few records). The few Limenitis ovipositions were mostly in morning-midday. Speyeria ovipositions were nearly all very close to midday. However, the data in general do not contradict the conclusion that females oviposit all day, during warm sunny weather, because afternoons in Colo. are often cloudy, so 10:00 to 12:30 closely approximates the most frequent time of day when both weather was warm and sunny and I was there to observe ovipositions. An ideal analysis would record exact time of day in the field, together with weather conditions, to derive a curve representing the amount of time spent in sunny warm weather in the field at each time of day, with which to compare to the oviposition curve; such data were not gathered. I probably spent somewhat more time in the field in the morning because afternoons are often cloudy. It is possible that a female only has a certain number of eggs mature enough to be laid during a day, and if the day is warm and sunny all day long, the female could lay eggs freely and run out of mature eggs by noon or so, giving results like those in Table 10. Perhaps this did occur at times, but I have no evidence to prove it. The conclusion, in contrast to mate-locating behavior (which genetically occurs only during part of the day in many butterfly species), is that oviposition occurs all day in warm sunny periods in all species I am familiar with, though occasionally a female may exhaust her day's supply of eggs while there is still sunny warm weather suitable for oviposition.

Table 10. Time of day of observed ovipositions (24-hour standard time). Headings are first three letters of subfamily or tribe or (capitalized headings) family totals or the overall total.

Time	PAP	Pap	Par	PIE	Col	Pie	NYM	Dan	Sat	Cha	Apa	Lim	Nym	Mel	Hel
7:30- 7:59															
8:00- 8:29				2		2	4								4
8:30- 8:59				5	2	3	4		2			1			1
9:00- 9:29	4	3	1	13	8	5	13		3				1		9
9:30- 9:59	1		1	28	20	8	20		4			3	2	1	10
10:00-10:29	7	5	2	45	19	26	36		10			2	8	1	15
10:30-10:59	2		2	59	21	38	45		5			4	14	2	20
11:00-11:29	3	3		36	25	11	41		6			2	6	4	23
11:30-11:59	2	1	1	70	35	35	41		7			1	10	4	19
12:00-12:29	5	1	4	24	9	15	45		13		1	4	12	4	11
12:30-12:59	1		1	15	10	5	43		8		1	2	7	3	22
13:00-13:29	1	1		21	7	14	21		3		2		9		7
13:30-13:59	17	15	2	17	13	4	20	1	1				6	3	9
14:00-14:29				5	1	4	11		2				4		5
14:30-14:59				4	1	3	17		5				4		8
15:00-15:29				12	4	8	3		2						1
15:30-15:59				3		3	1		1						
16:00-16:29															
16:30-16:59															
17:00-17:29				1	1										
Total	43	29	14	360	176	184	365	1	72	0	4	19	83	22	164
No Time	3	3	0	37	17	20	13	0	4	1	0	0	3	3	2

Table 10 (continued).

Time	LYC	Rio	The	Lyc	Eum	Pol	HES	Het	Meg	Hes	Pyr	TOT
7:30- 7:59	1			1								1
8:00- 8:29	2					2	2			1	1	10
8:30- 8:59	5					5	5	1		2	2	19
9:00- 9:29	24	1		3	10	10	10	2		5	3	64
9:30- 9:59	33			8	8	17	9	1		6	2	91
10:00-10:29	30			2	10	18	29			17	12	147
10:30-10:59	39			4	11	24	24			20	4	169
11:00-11:29	42	1		10	13	18	30	3		20	7	152
11:30-11:59	52			9	9	34	26			19	7	191
12:00-12:29	40	1		5	6	28	30	1	1	18	10	144
12:30-12:59	29			10	8	11	26			20	6	114

Time	LYC	Rio	The	Lyc	Eum	Pol	HES	Het	Meg	Hes	Pyr	TOT
13:00-13:29	24			5	6	13	25	3		13	9	92
13:30-13:59	18			1	7	10	11			9	2	83
14:00-14:29	23	1		1	5	16	11	1		8	2	50
14:30-14:59	9				6	3	5	1		2	2	35
15:00-15:29	8				3	5	2				2	25
15:30-15:59	3					3	4			2	2	11
16:00-16:29	1		1									1
16:30-16:59	2		1			1						2
17:00-17:29												1
Total	385	4	2	59	102	218	249	13	1	162	73	1402
No Time	32	1	0	4	8	19	22	0	0	14	8	107

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Egg Mimics and Egg Camouflage. Most Pieridae eggs turn orange after a day, and in Calif. and the tropics some plants have been reported to produce red egg-mimics to deter oviposition (females sometimes refuse to oviposit if they see another egg on the plant). But I have not seen any Colorado plants with egg mimics; indeed, the opposite was found, a butterfly egg mimicking a plant. The main hostplant of Nathalis iole, Dyssodia papposa, has orange-yellow foul-smelling glands roughly the size and shape of iole eggs. When these glands first evolved they may have been egg-mimics (if the color evolved before the glands' odor--this may have occurred, because most plant glands producing odor chemicals are not large or colorful). But an egg-mimicry origin is dubious, and even if true, the glands are no longer egg mimics because their foul odor presumably protects the plants now from herbivores and the glands are now ineffective in deterring oviposition (Dyssodia is the most common host, and the glands are common all over the plant so a female cannot avoid landing near them). After the glands developed their foul odor, N. iole eggs then apparently became mimics of the glands (by becoming orange-yellow, versus orange in other Pieridae eggs) in order to gain protection from predation by insect predators by mimicking an inedible foul-smelling gland. All things considered, the conclusion of egg mimicking foul-smelling gland is much stronger than the idea of gland mimicking egg. The scenario might have been this: N. iole laid eggs on D. papposa, the plants evolved orange egg-mimics to mimic the orange eggs of ancestral iole, the chemicals in the orange plant glands somehow had or developed an additional property of being distasteful to some herbivores so the egg-mimics evolved into foul-smelling glands, these glands now conferred enough protection to the plant that their orange color and former function as egg mimics was no longer needed and the color lessened to orange-yellow, then the butterfly eggs now could gain protection from predation by mimicking the plant glands so they became orange-yellow also. But a simpler hypothesis is that Dyssodia developed its glands independent of butterflies, N. iole began preferring it as a host because the plant glands reduced consumption by herbivores such as buffalo, antelope, and prairie dogs (also reducing consumption of eggs and larvae on it), and then eggs mimicked the glands in color (becoming less orange) to reduce predation by insect predators.

Most eggs are cream or pale green when laid, and turn somewhat darker later. The green eggs are camouflaged, of course. Papilio multicaudata, Coenonympha, Cercyonis, and Polites themistocles eggs develop reddish-brown dots for apparent camouflage. Papilio machaon-group, Atrytone, Anatrytone, Euphyes, "Amblyscirtes" simius, and Eparcyreus eggs develop reddish rings for possible camouflage.

But some eggs are not camouflaged. Some stay whitish during development (Parnassius, Oeneis, Lycaenini, some Eumaeini, many Hesperinae), and are not camouflaged. Most Pieridae eggs (except N. iole) turn orange as just noted, and Erynnis eggs turn orange or red. Agathymus alliae eggs become dull red, then silky bluish-gray.

Fragile Eggs. Eggs of Lethe eurydice were found to be so fragile that they are killed by drying of the leaf they were laid on if the leaf is clipped (to prevent death the eggs must be removed from the leaf by dissolving the glue with water). Eggs of other butterflies are strong enough to withstand this, and Satyrus californica, S. acadica, and Neophasia menapia even protect their hibernating eggs with a cover of clear copious glue, which forms a "glue window" in the Satyrus.

Oviposition Flight. Ovipositing females have a distinctive slow hovering flight, landing often on plants to test them for suitability. This hovering flight is rather obvious in most butterflies, except for those butterflies with slow wingbeat frequency (Pieris rapae, P. napi, and Satyrinae), in which preoviposition hovering is not as different from normal flight. Ovipositing Satyrinae fly slowly near the ground, but they do not flap their wings very

fast; the wingbeat frequency is faster than normal flight (which has slow wingbeat frequency), but slower than the wingbeat frequency of other butterflies. Also, some Satyrinae (Cercyonis) often let the egg fall from the abdomen rather than attaching it to a plant, and various alpine Satyrinae deliberately oviposit on large rocks, and some Oeneis oviposit on trees, so obtaining ovipositions of Satyrinae requires more careful watching than for other butterflies, because the observer must watch all females that flutter slowly and must follow them closely enough to see the extruded egg.

Papilio females continue to flutter while they oviposit, while other butterflies are generally motionless with wings closed (I cannot recall any oviposition in which her wings were spread). Hairstreaks do not flutter before landing and ovipositing, they merely land on the host then crawl to oviposit.

Egg Placement. Females generally land, head upward, on the plant and curve the abdomen down and forward to oviposit. Euphyes bimacula females also do this, but usually back down the sedge blade to the plant base before ovipositing. But females face head downward and curve the abdomen away from the wings and downward to oviposit in these species: Neophasia menapia, Nymphalis antiopa, Hesperopsis libya confertiblanca (new subspecies).

Females generally oviposit on the underside of leaves etc. However, females oviposit on top of leaves in the Papilio glaucus-group, Limenitis (in these two the female lands on a leaf, the leaf lowers under her weight and her body becomes nearly vertical as she lays an egg on top of the leaf tip), many Coliadinae (Colias, Nathalis, and relatives), Pholisora, Hesperopsis, Callophrys sheridanii frequently, and Plebejus icarioides sometimes. Euchloe ausonia often oviposits on top of flower buds. Several unrelated Lycaenidae crawl down plant stems and oviposit on litter at the plant base (most Lycaena except L. heteronea & L. cupreus, Harkenclenus titus sometimes, Satyrium fuliginosum, Plebejus melissa). Some species oviposit on twigs rather than leaves: Asterocampa celtis sometimes, Nymphalis antiopa, Lycaena arota, several Eumaeini species (Hypaurotis, Satyrium, Harkenclenus sometimes). Some oviposit on dead leaves low on the host: Ochlodes sylvanoides and O. yuma, and Lycaena on hostplants growing in water; some Satyrinae. Erebia epipsodea prefers to oviposit on a dead blade tip rather high in the turf and females can be somewhat acrobatic as they place the egg on dead grass blade tips. Some alpine species prefer to oviposit on large rocks beside the hostplant (Oeneis polixenes, O. melissa, Erebia magdalena, Lycaena cupreus snowi). Oeneis chryxus oviposits on branches (on the tree or fallen) above the host.

Egg Clusters. It is well known that Melitaeini and Nymphalis lay large egg clusters, and Neophasia lays about a dozen eggs in a row on a host needle. Less well known is the fact that some species oviposit in small clusters of a few eggs: Lethe eurydice (average 2.0 eggs/cluster), Boloria eunomia (2.9), Polygonia sometimes (1.9 in P. faunus hylas, 2-5 in P. satyrus), Harkenclenus titus sometimes (up to 5), Satyrium californica (3.7), acadica (3.2), sylvinus (~2), fuliginosum (usually 2).

Oviposition Away from the Host. Some species oviposit in unusual places. Boloria often oviposit on litter up to 10-20 cm or more from the host; Boloria eunomia lays eggs mostly on green seedlings, and B. titania usually oviposits on green plants, though in both species the oviposition plants are often not hosts. Boloria frigga and many Satyrinae (Erebia theano and callias, Oeneis uhleri, Erebia epipsodea, and Coenonympha tullia often, Cercyonis oetus sometimes) and Ochlodes sylvanoides oviposit mostly on DEAD blades of grass/sedge on or near the host. Oeneis chryxus oviposits on branches/bark of lower limbs or fallen limbs over or very near the Carex hosts. Cercyonis and at least three Polites often let the egg fall from the abdomen tip rather than attach it to a plant; they oviposit on or near the hosts, which grow in swards so the hatching larva has no problem finding food. Polites themistocles usually oviposits on small dicotyledon plants near the hostplant grasses (its hosts also grow in swards), and Polites draco does this for about half its eggs. Polites sabuleti often oviposits on inedible Juncus, Equisetum, etc. near the grass hosts. And Polites mystic, sonora, and peckius usually rest on the hostplant and drop eggs from the abdomen tip. Female Speyeria of dryland species generally delay oviposition until late summer, when they often oviposit in litter under shrubs or in hollows between dense grass, where violets will not appear until the next spring. Parnassius oviposits apparently randomly on low vegetation (often various grasses) averaging 17.4 cm away from the hostplant. Lethe eurydice and Coenonympha tullia usually oviposit on a host, but sometimes oviposit haphazardly nearby. Some Lycaenidae (most Lycaena, Satyrium fuliginosum, S. titus, Plebejus melissa) oviposit on hostplant stem bases, or on litter up to 5-10 cm away. Several late-summer Hesperia, esp. H. juba, place eggs on seed heads of Bromus tectorum and larvae then eat the seedlings beneath.

Thermoregulation seems to be the primary goal in choice of oviposition sites in some species. Four alpine species lay on large rocks, which would produce a more constant temperature for the egg, rather than the alternating hot and cold air temperatures of partly-cloudy alpine weather. Oeneis polixenes and Melissa oviposit on tiny rock walls or banks of vegetation that face the morning sun, evidently to speed larval development in the cool alpine zone. Erebia magdalena and Lycaena cupreus snowi oviposit just over the edge of rocks also, which may have a similar purpose in solar heating. At a lower-altitude site, Neominois ridingsii usually oviposits on the host, but in hot weather lays on top of shrubs above the hot ground; in this species excess heat is the problem. The hay-feeding skippers also seek cooler temperatures; they mostly oviposit in partial shade at comparatively hot low altitudes and have only one generation per year, a slowing of development compared to many other skippers there that have several generations.

Hostplants of Haphazard Ovipositors. Considerable progress was made on elucidating the natural hostplants of species which oviposit haphazardly. A procedure was developed to determine main hostplants of haphazard ovipositors: 1) recording all plants near each oviposition/egg/larva found (the logic being that adults oviposit on or near the main hostplant in nature, and of course that adults must be associated with the hostplant in nature); 2) conducting lab feeding tests of plants found near eggs to prove that larvae eat and survive on the hostplant(s); 3) then, the plants that are nearest the eggs/larvae in nature and that are most palatable to larvae are determined to be main hostplants, plants that are eaten in the lab but are less often oviposited near in nature (less often associated with adults in nature), are determined to be occasional hostplants, and lastly, plants that females occasionally oviposit on but larvae refuse are determined to be occasional oviposition-site non-hostplants (these are of little interest because haphazard oviposition guarantees many of them).

Females of Speyeria and Boloria oviposit rather haphazardly near the hostplants. Females of "dryland" Speyeria (aphrodite, callippe, edwardsii, coronis) have adult diapause and oviposit in late summer, either near green violets or often under bushes and in hollows where violets are dormant for the year but will appear the next spring; "wetland" Speyeria (nokomis, mormonia, atlantis) lack a female diapause and oviposit only near green violets. Larvae of most Boloria are rather polyphagous, in lab eating about half the dicotyledon species present at each locality, and various Boloria have similar broad lab host preference (though a few are host-specific); but my extensive oviposition records now show that hostplant choice is more specialized in nature, where B. eunomia remains polyphagous, but B. frigga chooses Salix, and B. titania and B. freija greatly prefer Vaccinium. Boloria bellona and probably B. selene are exceptional in eating only one genus, Viola. Boloria inhabit bogs or other wet places, and bog butterflies in general are rather polyphagous; for instance the willow-bog Colias scudderii is semipolyphagous (Vaccinium, Salix, Polygonum, perhaps Viola).

Do grass/sedge feeders choose all grasses/sedges haphazardly? This is partly true for Satyrinae, which oviposit very haphazardly (females usually place the egg on dead substrates such as dead grass blades or rocks). Despite considerable effort, Satyrinae species (Coenonympha tullia, Erebia), still seem to show little discrimination among grasses/sedges. Even Lethe eurydice, reported to feed on sedges elsewhere, eats grasses most often in Colo. Erebia epipsodea and Cercyonis seem to prefer to oviposit on Poa (epipsodea and pegala on P. pratensis, oetus on its close relative or subspecies P. aquasizensis), and lay less often on other grasses and sedges. Neominois and perhaps Cercyonis meadi alamosa prefers Bouteloua gracilis at certain shortgrass prairie areas, though they eat other grasses elsewhere. Oeneis alberta eats bunchgrasses (Festuca idahoensis), O. uhleri at least several turf and bunchgrasses, O. chryxus several Carex growing in the shade of trees, O. polixenes (and perhaps O. melissa) probably Carex rupestris drummondiana most often and grasses less often. It may take a large amount of effort, both in nature and lab, to determine the main natural hosts for many Satyrinae, because females oviposit somewhat haphazardly, and I have never found a Satyrinae larva in nature, evidently because larvae do not make leaf nests and larvae are camouflaged and must spend most of their (day)time within a clump and only feed at night.

But Heteropterinae and Hesperinae species choose only some of the grasses/sedges available in the habitat: each insect usually eats a number of plant species, but they are chosen from only one type of grass or sedge (the polyphagous Qarisma qarita is exceptional in ovipositing on a very wide variety of grasses and sedges, of many sizes and shapes, and larvae grow on grasses and sedges equally well in the lab). For instance, interesting differences in hostplant preference of four Hesperia species are documented by large sample

sizes: a comparison of the grasses preferred by different Hesperia species at the same site and at different sites indicates that females choose their hosts primarily by biochemical means rather than by size or shape or degree of succulence. Hesperia juba is the first butterfly known to have a generation that depends greatly on winter annual grasses (grasses which are dead in summer). H. juba oviposits on the perennial green grass Bouteloua gracilis, and only various green grasses are chosen during the generation that flies in May-June, but the generation that overwinters as larvae also oviposits (in Sept.-Oct.) on dead seed inflorescences of the dead winter annual grass Bromus tectorum and on "dead" clumps of a winter perennial Poa secunda, and the tiny larvae crawl to the ground and feed on small green shoots of both of these, shoots which grow only in fall-spring. A faster larval growth rate allows H. juba to produce two generations where other Hesperia have only one. H. comma assiniboia prefers Carex sedges but is a generalist and also chooses Bouteloua gracilis and occasionally dead Bromus tectorum inflorescences (larvae eat the tiny green shoots) as well as (rarely) four other grasses; H. comma colorado also eats Carex. H. leonardus pawnee, H. l. montana, H. uncas, H. viridis, and H. pahaska prefer Bouteloua gracilis. H. nevada prefers Festuca saximontana (2nd choice Koeleria macrantha, 3rd choice Stipa comata) in the Front Range, Festuca idahoensis at western sites. Polites draco at the first site prefers Koeleria macrantha and Poa pratensis. H. ottoe, Polites origenes, Atrytone aroqos, and Amblyscirtes phylace prefer the "hay bunchgrass" Andropogon gerardii, whereas the related P. themistocles (and P. mystic and P. sonora) prefer turf grasses esp. Poa, and Amblyscirtes oslari prefers wide-leaf Bouteloua curtipendula. Polites sabuleti chooses "crunch grasses": several alkaline-tolerant tough dry low grasses that "crunch" when stepped on. These differences between species of Hesperia and Polites may show that hard work and large sample sizes may be necessary to demonstrate real hostplant preferences of grass/sedge-feeding butterflies that oviposit somewhat haphazardly.

While Hesperia show evidence of biochemical hostplant choice, the similarity of hostplant choice of Piruna pirus, Poaes zabulon taxiles, Ochloides sylvanoides, Ancylorhiza numitor, and Amblyscirtes vialis--all choose "hay" grasses (wide-leaf usually tall non-clumped grasses), usually in shade--seems to indicate visual choice of hostplant, because many taxonomically unrelated grasses are chosen (14-24 for each of the best-known first three species).

This hay-feeding Lepidoptera guild in C Colo. includes only one moth, the noctuid Apamea finitima (Guenée)(det. Douglas C. Ferguson, 2 adults 2 pupae ~7 larvae deposited in Smithsonian); its larvae silk hay leaves together; I found larvae on Andropogon gerardii (3 records), Andropogon (Schizachyrium) scoparius (1), Dactylis glomerata (2), Agropyron (Elymus) canadensis (1), Dichanthelium oligosanthos var. scribnerianum (1), Bromus (Bromopsis) porteri (1), Bromus (Bromopsis) lanatipes (1), Bromus (Bromopsis) inermis (1).

Andropogon gerardii also has wide leaves, but is somewhat shorter than most "hay" grasses; it can be called a "hay bunchgrass." It must be biochemically different from the hay grasses, because it is the main host of four species (Hesperia ottoe, Polites origenes, Atrytone aroqos, Amblyscirtes phylace) which do NOT eat hay grasses; the first three species evidently followed the grass westward from the Great Plains.

Lab Hostplants of Grass Feeders. In the lab, most grasses and perhaps even sedges are suitable food; most Satyrinae may eat both well. Poa pratensis has proven to be an acceptable lab host of every grass-feeding butterfly. The only exception is Amblyscirtes, because A. oslari and A. vialis young larvae died eating it; the hypothesis is that Amblyscirtes evolved in deserts of the Mexican Plateau and larvae require drier leaves than Poa pratensis, which is a moist-meadow grass.

C3 Versus C4 Grass Hostplants. Grasses--like other plants--may have either C3 "cool season" or C4 "warm season" types of photosynthesis. C4 plants photosynthesize at a greater rate (and photosynthesize more at high temperature so grow more later in the season), utilize more CO₂ and more light, require half as much water, produce different initial compounds in the chemical process, etc. than C3 plants. There have been reports that herbivores (grasshoppers) shun C4 grasses and the "sheath barriers" to utilization of starch prevents herbivores from digesting C4 grasses; however steers prefer C4 grasses, and recent research has proven that lepidoptera caterpillars (the butterfly Paratrytone melane, Barbehenn 1992)--unlike grasshoppers--can digest the nutrients inside plant cells even if the cell walls are not broken by the jaws or during passage through the intestine (Satyrinae and Hesperinae have shear mandibles without teeth, and Heteropterinae mandibles have weak teeth, so these grass-feeders do not crush their food with jagged molars as other butterflies and grasshoppers do). Waller

& Lewis (1979) classified these plant characteristics and 632 grass species as to C3 or C4, so I sorted the butterfly grass hosts into C3 and C4 types to see if butterflies prefer one or the other. 179

Of course there are definite associations of butterfly species with C3 or C4 grasses. Most Colo. grasses are C3, and most host grasses are C3 also. Some butterflies eat both types: Coenonympha, Neominois, Oarisma, Hesperia juba & comma, Polites sabuleti. The hay feeders (Piruna, Ochlodes sylvanoides, Poanes zabulon taxiles) eat mostly C3 but eat a few C4. Some eat mostly C4 but some C3: Hesperia leonardus, Polites origenes. Cercyonis pegala and oetus eat mostly C3, C. meadii perhaps C4. Most Hesperia eat C4, H. nevada eats C3 (rarely C4). Amblyscirtes vialis eats C3, A. oslari and phylace eat C4. Some C3 grasses are mostly shunned by butterflies (Danthonia, Vulpia, Oryzopsis, Stipa); some C4 grasses are mostly shunned by butterflies (Aristida, Buchloe, Sporobolus, Panicum). But do the butterflies choose their hosts on the basis of C3 or C4 photosynthesis rather than other traits such as size and shape and biochemicals?; there is no evidence that they do, and the associations that exist may just be statistical coincidence. And the theory that herbivores in general dislike C4 grasses is clearly erroneous, because there is proof that some butterflies survive very well on them: Bouteloua and Andropogon gerardii are C4 grasses preferred by many butterflies.

Shape of Plant Affects Oviposition. No doubt many butterflies use shape in part to select their oviposition site. For instance hay-feeding skippers probably select their oviposition site by height of grass, width of leaf, amount of shade, as well as by using biochemicals; females of the hay feeder Ochlodes sylvanoides probably check to see if the plant looks like a grass and has grass biochemicals, check to see if it is tall and has leaves at least ~4 mm wide, check to see if the plant is near shrubs or trees (in semi-shade), then find a dead dried lower leaf to oviposit on. The resemblance of linear Arenaria to grass probably led to the oviposition of several Hesperia comma eggs on it. Platycodon grandiflorus hostplants have been reported to be only Trifolium; however, females from the Colo. Front Range prefer to oviposit on two Astragalus in two subgenera, perhaps because their inflorescences are spherical like those of Trifolium. And Limenitis weidemeyeri evidently chooses hostplants with deciduous shrub/small tree shape rather than by using biochemicals.

But there are numerous examples of hostplants of one species that vary greatly in shape or size, indicating that biochemicals are more important for host selection. For instance, legume feeders do not seem to use leaf size or shape to choose oviposition site, because the host leaves eaten by many legume feeders vary from very small to large, with three leaflets per leaf or one leaflet or many; for instance, the giant 3-parted leaves of Thermopsis look nothing like the tiny multi-pinnate leaves of Astragalus flexuosus; and Dalea jamesii has a strange inflorescence with yellow flowers among vast white fluff, that looks nothing like the inflorescence of other legumes, yet Hemiarctus isola likes it. Likewise, Apiaceae, Malvaceae, and Aster hosts vary considerably in leaf size and shape, etc. Polygonia satyrus oviposits on two hosts whose leaves are grossly different in shape. The Lycaena rubidus hosts vary from tiny to gigantic (1000 times larger). And Hesperia nevada prefers to oviposit on Festuca, even though the preferred species vary from small to large in size; an analysis of its hosts clearly suggests that females choose them biochemically.

Polyphagous Species. Strymon melinus was found to be the most polyphagous butterfly, eating flowers/fruits of numerous families. Papilio multicaudata, Limenitis weidemeyeri, Precis coenia, several Polygonia, Nymphalis antiopa, Euptoieta claudia, Celastrina lucia-type, and Callophrys affinis homoperplexa are less polyphagous but eat plants of several families, the last two only on flowers/fruits. Vanessa cardui eats several families also, but Cirsium is greatly preferred. Boloria eunomia is the most polyphagous Boloria, eating many families, and B. titania and freija are much less polyphagous (preferring Vaccinium), while B. frigga, bellona, and selene are essentially monophagous. The most polyphagous grass/sedge feeder was found to be Oarisma parita which eats all types of grasses as well as sedges. Lethe eurydice eats tall green grasses and sedges, and some Satyrinae--difficult to study--may also eat many grasses and sedges.

Hostplant Switching. The normally scarce Euphydryas chalcedona/anicia capella ordinarily feeds on several Penstemon, but has added an introduced abundant weed Linaria genistifolia macedonica in one area, where the population has exploded. The geographic restriction of the latter explosion suggests that there has been natural selection for the ability to eat the introduced hostplant. A case of larval hostplant switching was discovered in which Phyciodes picta (Nymphalidae) originally fed on Aster (Asteraceae) but now feeds on the recently introduced Convolvulus arvensis (Convolvulaceae), a completely unrelated weedy vine. So in

Larval competition. In general, there seems to be an absence of larval competition among Colorado butterflies.

The main evidence for lack of competition is that many butterfly species eat certain popular plants, while other closely-related plants are shunned. There are many popular plants. For example, in Colorado, numerous butterflies eat Bouteloua gracilis leaves (12 species, and 2 others rarely, 1 other probably), Lupinus argenteus (10 species [4 eat leaves, 2 eat mostly leaves, 4 eat fruits], and 4 others eat leaves of other Lupinus), Quercus gambelii leaves (8 species), Ceanothus fendleri (8 species [1 rarely][6 leaves, 2 fruits]), Poa pratensis and the related ssp. or sp. Poa agassizensis leaves (17 species, of which ~9 species eat them often, ~4 occasionally, 4 rarely; 20 species total eat Poa), Bromus inermis (8 species, 5 often, 3 occasionally), Salix exigua leaves (7 species, and 6 others eat other Salix), Astragalus bisulcatus (8 species [4 leaves, 1 mostly leaves, 3 fruits]), A. flexuosus (7 species [3 leaves, 1 mostly leaves, 3 fruits]), A. adsurgens (6 species [2 leaves, 1 mostly leaves, 3 fruits]), A. agrestis (6 species [3 leaves, 3 fruits]), (14 spp. eat various Astragalus [7 leaves, 2 mostly leaves, 5 fruits]), Festuca idahoensis leaves (6 species, 3 of which also eat the closely-related Festuca saximontana leaves, and 2 other species eat the closely related Festuca brachyphylla leaves), Viola nuttallii leaves (6 species [1 rarely], and 8 others eat other Viola spp. leaves), Medicago sativa (6 species [2 leaves, 1 mostly leaves, 3 fruits]), Andropogon gerardii leaves (7 species [1 rarely]), Thermopsis divaricarpa (6 species [5 leaves, 1 fruits]), Lathyrus leucanthus (6 species [5 leaves, 1 fruits]), Prunus virginiana (5 species often [3 leaves, 2 fruits/leaves], and 2 species sometimes [1 fruits, 1 fruits/leaves]), several Descurainia spp. (6 species [1 leaves, 5 mostly fruits]), Agrostis gigantea leaves (6 species, though not the sole host for any), Carex pennsylvanica heliophila leaves (6 species, of which 3 species eat it usually, 3 sometimes; 18 species in all eat Carex spp.), Trifolium repens (6 species [2 leaves, 4 fruits, 1 rarely], and 4 other species eat other Trifolium [2 leaves, 2 mostly leaves]), Eriogonum umbellatum (5 species [2 leaves, 3 fruits], and 5 other species eat other Eriogonum [1 leaves, 4 fruits]), Arabis glabra leaves and fruits (5 species [1 leaves, 4 fruits], and 3 others eat other Arabis [1 leaves, 3 mostly fruits]), Koeleria macrantha leaves (9 species, though just an occasional host for all but 1), Agropyron spp. leaves (11 species total, but only 5 species eat the most-often chosen A. trachycaulum and canadensis, only 4 eat A. repens, ambiguus), Vicia americana (5 species [3 leaves, 2 fruits]), etc.

In addition, numerous closely-related pairs of butterflies have nearly identical hostplants, suggesting that they compete little if at all (Papilio zelicaon-polyxenes, Colias eurytheme-philodice, Euchloe ausonia-olympia-Pieris rapae-Pontia protodice-P. callidice, Speyeria callippe-coronis-edwardsii, many Lycaena, many Satyrrium, Callophrys polios-augustinus, Hesperia pahaska-viridis, Thorybes pylades-mexicana, Erynnis incl. persius-afranius, martialis-pacuvius, Pholisora catullus-mexicanus, etc.).

The fact that certain popular plants have numerous butterflies that eat them suggests that there is no competition for food on them. It should also be noted that all these popular plants are common in nature; in fact, there are no butterflies in Colo. that I know of that eat truly rare plants. Semipolyphagous species may occasionally eat locally scarce plants, but obviously there are no butterfly species that are specifically adapted to prefer rare plants. The obvious explanation is that any butterfly species that was restricted to eating a rare plant would soon become extinct because the females could not find enough hostplants for oviposition. Rare plants in general do not have host-specific insects feeding on them because such insects become extinct, so the reasons for their rarity must be due to poor chemical or physical defenses against polyphagous herbivores that eat them, "less viable genes" such as susceptibility to microbial pathogens, extinction of host-specific pollinators, or some such cause. (It has been proven that insect herbivores can greatly reduce the density of an abundant plant, for instance the beetle Chrysolina quadrigemina was introduced to control Klamath Weed Hypericum perforatum in northern California, and these plants, formerly superabundant, are now uncommon--but they have not become rare as a result. If the plant did become rare locally, the insect would die out at that site.)

In contrast to these popular plants, most families and genera of Colorado plants are not eaten at all by butterflies. A survey of the plant families and their popularity as hosts is useful, especially to note the plants that are closely related to popular hostplants yet are shunned by butterflies. Among Brassicaceae, Lesquerella montana is shunned by butterflies, Thlaspi arvense is

seldom chosen (this plant was introduced from Eurasia and the native butterflies have not yet adapted to it), and Erysimum is rarely chosen. The remaining Brassicaceae and Capparidaceae are popular hostplants that seem to be chosen with little preference (though Polanisia has no records so may be shunned, but it is uncommon), except that some butterflies prefer certain habitats so choose only Crucifers growing there (for instance Pieris prefer wet habitats and the crucifers there, while Pontia protodice is migratory so often chooses weedy crucifers). Some Chenopodiaceae are popular hosts, but the superabundant Kochia is shunned. Among Fabaceae, Astragalus flexuosus is one of the most popular, and it also has the smallest leaflets. Several legumes are unpopular, including Oxytropis which is almost never chosen, and Psoralea which is covered with small glands and is never chosen (even though its flowers are popular with Plebejus melissa adults and melissa larvae eat other legumes). Trifolium pratense is by far the least popular Trifolium, perhaps because of some repellent biochemicals. The legume feeders usually feed on a number of genera, but most are somewhat specialized among genera; for instance Colias do not seem to prefer Lupinus, whereas several Polyommata eat only Lupinus. Butterflies that eat Ribes prefer some species and dislike others. Among Scrophulariaceae, some Penstemon, some Castilleja, and Besseyia seem to be the only popular genera in Colorado so far, and such fairly abundant plants as Verbascum (all introduced), Linaria, Scrophularia, Pedicularis, Veronica, and Mimulus are underutilized. Eriogonum feeders, esp. Polyommata, discriminate among species and even among varieties. Danaus plexippus eats Asclepiadaceae but ignores the closely-related Apocynaceae. Butterflies that eat Asteraceae or Rosaceae generally choose only one or a very few genera or species, whereas Malvaceae or Apiaceae feeders seem to eat all the genera. Stipa comata is eaten by 7 species, but all but one eat it only occasionally or rarely, so this grass is an unpopular hostplant, and I doubt that any butterfly eats it often; its abundance in nature may be because the leaves are so tough that most herbivores refuse it. Other Stipa are also shunned, except for S. scribneri which is eaten by two species and is preferred by one. Panicum virgatum is a large grass but is shunned evidently because of repellent or unattractive biochemicals. Such grasses as Aristida purpurea, Danthonia parryi, Festuca arundinacea, Lolium perenne, Oryzopsis exiguus, Setaria viridis, Sporobolus cryptandrus, Buchloe dactyloides, and Vulpia octoflora are common but are mostly shunned by grass-feeding butterflies. Some butterflies choose several widely separate plant families, which suggests some biochemical explanation: Polygona faunus on Salix and Ribes, Nymphalis antiopa on Salicaceae and Ulmaceae, Callophrys affinis homoperplexa on Ceanothus and Eriogonum.

Some butterflies avoid competition on the same hostplant by eating different parts of the plant, such as flowers/fruits versus leaves. For instance some legume feeders eat leaves, whereas others (such as Glaucopsyche lygdamus) eat flowers/fruits. The same is true of Brassicaceae feeders such as most Pieris which eat leaves, Pieris sisymbrii/Euchloe which eat flowers/fruits, etc. Callophrys augustinus and polios both feed on Arctostaphylos uva-ursi, but do not compete for food because C. augustinus eats mainly flowers-fruits, C. polios young leaves. On Quercus gambelii, Erynnis brizo eats only seedlings, whereas E. telemachus eats young growth of large and small plants. But most of the butterflies that eat the same hosts eat the same plant parts (usually leaves).

Competition for larval food between species must be rare, because Colo. hostplants are almost never defoliated or denuded by butterfly larvae. If there is any competition involving butterfly larvae, it is between butterfly larvae and other insects that feed on the same plants; but because the butterfly hostplants are almost never defoliated, it can be concluded that competition is very small among these other insects also. Defoliation generally happens only on the favorite hosts of Vanessa cardui during its vast migrations about every 7 years, on small hostplants eaten by butterflies which oviposit in large egg clusters (Melitaeini, Nymphalis), and on a few isolated inflorescences chosen by butterflies that eat flower buds/fruits. Flower buds/fruits are the most limited food supply, and the occasional competition for food that must result as maturing fruits are exhausted must be the most common larval competition in butterflies.

Convergence. In contrast to the absence of larval competition, numerous examples of convergence were observed. The Oarisma qarita larva amazingly resembles Satyrinae: it lacks a nest like Satyrinae, has camouflaging stripes like Oeneis, and is polyphagous like many Satyrinae. One of the most striking convergences involves Hesperia ottoe and Polites origenes. These two genera are so closely related that they are probably just subgenera; all have underground/litter larvae and feed on narrow-leaf grasses, except H. ottoe and

P. origenes convergently feed on fairly-wide-leaf Andropogon gerardii and have aerial larvae in leaf-tube nests. Evidently underground soil/litter nests are more difficult to make than aerial leaf nests, and enlarging the nest by removing soil in place must be especially difficult, so the switch to a wide-leaf grass rapidly led to evolution of the aerial nest. The underground larval nest itself has been convergently evolved by grass feeders eating turf grasses or short narrow-leaved grasses. Vanessa atalanta and Piruna pirus have rolled-leaf nests that hang from a narrowed chewed midrib/stem, perhaps to diminish predation by ants tightrope-walking the narrow midrib. Numerous taxa convergently evolved rolled-leaf larval nests (Anaea, Vanessa atalanta, Hesperiidae), egg clusters, feeding on inflorescences rather than leaves, ovipositing on litter near the host, etc. Many species convergently have the same hostplants, as already noted. Perhaps the most interesting are the hay feeders; once a species evolves to feed on one hay grass it is then able to eat them all (except for certain exceptional wide-leaf grasses such as Andropogon gerardii which is eaten only by specialists, Panicum virgatum which seems to be biochemically shunned, Festuca arundinacea which is probably shunned because of toughness, etc.). The larval heads of most aerial-nest Heteropterinae/Hesperiinae (Piruna, Lerema, Ancyloxypha, Copaeodes, Thymelicus, Atrytone, Anatrytone, Ochlodes, Euphyes, Amblyscirtes) have red-brown stripes, which may be a type of camouflage; underground larvae generally have dull unstriped heads, as do some other aerial larvae. Larvae of Papilio machaon-group, Pontia sisymbrii, and Danaus plexippus are similar in appearance and evidently form a Mullerian mimicry complex (Scott 1986b). Euchloe and Pontia protodice-callidice larvae are very similar in appearance, even though these are supposedly not very closely related, evidently because of convergent camouflage to match the pale and dark lines while resting on narrow pods ("siliques"), or because they ARE actually very closely related phylogenetically.

Underground Larvae. Alpine Parnassius phoebus larvae may hibernate underground the second winter. Neominois ridingsii has underground pupae, and some Oeneis and Erebia pupae may also be underground or in litter. Many Hesperiinae larvae are underground: Hylephila phyleus, Yvretta rhesus, all Hesperia except otloe, all Polites except origenes, Atalopedes campestris, not Amblyscirtes simius, and perhaps Atrytonopsis vierecki. The common link among these is that larvae eat narrow-leaved turfgrasses, or narrow-leaved short grasses.

Taxonomic Changes. Biological research showed that Anatrytone logan is a distinct genus from Atrytone arogos; in contrast, Hesperia and Polites and Atalopedes are nearly identical and are probably subgenera. The immatures and underground nest of "Amblyscirtes" simius reinforce the conclusion that it does not belong to Amblyscirtes. Hostplant differences led to the conclusion that there are two--not one--Celastrina species in Colo.

Anti-Predation Behavior. Pieris rapae and Colias older larvae whip violently from side to side when touched or picked up, to deter predators. Nymphalis antiopa pupae twitch violently also when disturbed. Nymphalis milberti young larvae seem to have an ant-repellent chemical from the ventral neck gland; perhaps all larvae with this gland (Hesperiidae, Pieridae, and Nymphalidae) have this ant-repellent chemical.

"Dracula Caterpillars" were discovered, the older larvae of Amblyscirtes (except for the "Amblyscirtes" simius). The head of these larvae have two chitin fangs, just above the usual mandibles, that seem to be used to puncture and tear predators (the fangs are apparently not used in nest construction). These larvae are found outside their nest in daytime much more often than other Hesperiinae, and are more acrobatic in their movements.

Construction of larval nests deters predation. Vanessa atalanta and Piruna pirus both make leaf tube nests that droop because the leaf basal to the nest has been chewed around the midribs, perhaps to make access to the nest harder for predators like ants. Atrytone arogos forms a leaf nest of two leaves, and chews the leaf bases until they form two stilts, perhaps also to deter predators.

Nest Shape. Some unusual larval/pupal nests were discovered. Parnassius larvae worm themselves into small spaces such as pebbly soil, and evidently overwinter in loose soil or debris, partly silked together. Piruna pirus makes an unusual hanging silked-leaf nest, by rolling the leaf into a tube as usual but then chewing the grass leaf down to the midrib for several cm basal to the tube, so that the tube nest dangles at a steep angle from the bare midrib. The Piruna nest is reminiscent of the Vanessa atalanta silk-leaf nest which is also a dangling tube where the leaf edges are bent upward around the larva, but the leaf dangles because the larva chews into the leaf base at and near the midrib. Polygonia satyrus makes a leaf nest by bending the leaf edges downward while the

larva rests on the leaf underside, but the main leaf vein is not cut. Hibernating Atrytone arogos make a typical Hesperinae rolled-leaf nest out of two grass leaves, but it is unusual in resting on two "stilts" formed by chewing the two leaves nearly to the midrib below the nest, and the upper end of the nest is closed with a silk screen. Papilio multicaudata and relatives rest on a leaf that is bowed upward somewhat with silk. Nymphalis milberti young larvae live in a silk nest, and older larvae rest on top of a leaf that is curled upward somewhat but usually not joined together above larva. Vanessa cardui & carye make a silk nest on top of a leaf, while V. virginensis silk several leaves together for a nest. Boloria improba pupae rest horizontally in a loose silk nest among leaves. Euphydryas chalcedona/anicia young larvae live in a silk web nest. Pieris sisymbrii silks the pods (siliques) together, but does not live inside a nest. Anaea andria larvae make rolled-leaf nests like Hesperidae. Apodemia nais larvae live between silked-together leaves. Oarisma garita is highly exceptional in lacking the usual silked-leaf nest of all other Hesperidae, and it also has camouflaged striped larval color, in contrast to the noncamouflaged unstriped green or tan color of most Hesperidae. O. garita has "satyr envy": it resembles Satyrinae such as Oeneis in its hostplant polyphagy, striped larval body pattern, and lack of larval nest.

Lack of Butterfly Communities. Butterfly "communities"--functionally related sets of species--do not exist, except as accidents of their larval and adult hostplants and climatic tolerances. For instance, a colony of Euphilotes rita coloradensis was found growing on Eriogonum effusum growing on pure sawdust from a former lumber mill. And a colony of Harknclenus titus was found on a pure stand of Prunus virginiana melanocarpa growing on pure sand dunes. E. rita pallescens occurs on pure sand dunes in Nevada. Lycaena helloides & L. hyllus sometimes occur on pure stands of Polygonum coccineum. Polites themistocles and P. peckius sometimes occur on pure Poa pratensis lawns. Obviously, the only butterfly "communities" that exist are very simple ones, consisting of hostplant, butterfly eating hostplant, and perhaps parasitoid(s) eating butterfly immatures (most parasitoids on butterflies evidently eat many lepidoptera species, but this is not well known). Predators of butterflies are generalists that eat many insects so do not belong to a functional butterfly community.

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DEDICATION

This research would not have been possible if the profession of biology/entomology had provided good jobs (if it had, I would have spent the time that I spent researching this paper, on teaching more biology students who could not get jobs, etc.). Entomology is a Jekyll and Hyde profession: go to college because you like bugs and plants and nature and research, and become Dr. Jekyll the learned scholar; graduate and find the only jobs are for Mr. Hyde the exterminator. My research would not have been possible without the hundreds of colleges and universities across the country and their thousands of teachers who crank out tens of thousands of biology graduates yearly, only ~10% of whom can now find jobs; if they had not glutted the job market I surely would have been making money instead of doing the present research. (Clearly, the only useful degrees related to biology today are in biochemistry, gene transplanting, and medicine [nursing, M.D., etc.]; today's "environmental" jobs are only for environmental engineers, organic chemists, hydrologists, toxicologists etc., biologists need not apply.) Too, this research would not have been possible without the racial and sexual discrimination initiated and practiced by the U.S. federal government and forced upon federal agencies and lesser governments and colleges and large private companies (nearly all entomologists except roach exterminators must work for one of these) under the name of "affirmative action"; blatant discrimination in which women, minorities, veterans, handicapped, etc. etc. (even the Purple Wurlpulores from Hoogistan) are all given preference in hiring, except white males, even though white males form a minority of less than 30% of the U.S. population. Too, this paper would not have been possible were it not for those insecure incompetents who are afraid to hire high-quality persons because the new person might threaten their future status in their heirarchy. Unfortunately there is little reward in entomology for innovative or top-quality work, and the intelligent person would be well-advised to go into some profession such as engineering or medicine or the construction skills or baking where individual competence can translate into concrete rewards and higher income. And if a person has the persuasive personality and fund-raising skills necessary to merely scrape by in biology today, he would be well-advised to put those skills to far more rewarding use in another field such as sales and marketing.

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